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SAVING POWER IN CAR OPERATION.

An ingenious plan has been tried recently on the electric railway system of Frankfort-on-the-Main for economizing in the current consumption of the cars. It had been found that the energy taken by these cars was increasing steadily. To check this increase a simple ten-day clock movement was placed on each car and a small magnetic brake arranged so as to stop the clock whenever the current was shut off, but to allow the clock to run as long as current was passing through the motors. These clocks then register the total time during which current is supplied to the motors. The conductor is required to record on his report slip the reading of the clock at the end of each run and the number of the car.

The method of determining from these readings the skill of the motorman depends upon the principle that the greatest economy is obtained when the car is accelerated rapidly and then allowed to drift until near a stopping point. By means of a coefficient time readings are made to yield figures which indicate the efficiency of the motorman. If his average figure is not satisfactory he is taken in hand and retrained. It is said that this means has reduced the energy consumption on this railway system about thirteen per cent and that the bottom has not yet been reached. Incidentally, it has not been found necessary to mount the clockwork on springs, as the jarring does not affect it; and since it runs only a small part of the time during each trip, it need be wound up only once in six weeks. This is surely a simple way of reducing one factor in the cost of railway operation.

A NEW ALTERNATOR.

How often we have been told that one of the great advantages of the alternating-current system is the simplicity of the generator. Here there need be no commutator, the only moving contacts being simple slip rings, upon which brushes press. Sparking is entirely avoided and the construction of the armature may be made simple. In fact, if desired, the armature itself may be stationary and the field revolved; or, we may even go further and adopt the inductor type, in which the only moving part is a mass of iron. Nothing, we have been told, could be simpler or more nearly ideal than this. And another advantage not infrequently urged for the alternator is the high electromotive force which can be generated in it without particular difficulty or danger. Large machines can be made which deliver 10,000 volts or more directly to the line wire, thus doing away with step-up apparatus and other similar auxiliary appliances.

These advantages of the alternator have usually been admitted, and the advocates of the direct-current system have sought to offset them by pointing out advantages of their system not possessed by the alternating. In fact, we have even gone so far as to try to develop a direct-current machine without any commutator. Only recently was a large dynamo of the so-called homopolar type described, which really was a remarkable machine, since, without the use of any commutator, it developed about 300 kilowatts at 500 volts, direct current.

It is therefore rather astonishing to read the description of a new alternating-current generator which makes use of a commutator, or, rather, which is really little more than a pair of commutators. And, more than this, the machine is built on the homopolar principle. A homopolar generator with two commu-

tators and delivering alternating currents is truly a strange combination. Nevertheless, such a machine has recently been patented in England by the British Thomson-Houston Company.

This alternator in principle is simple. The inductors or conducting bodies in which the electromotive forces are induced are segmental in shape and mounted radially so as to form two drums. These drums are attached to a common shaft, and suitable conducting wires connect the lower extremities of the inductors in pairs. The inductors themselves are of magnetic material and carefully insulated from one another and from the shaft upon which they are mounted. These parts of the machine resemble closely the ordinary commutator of a direct-current dynamo forming, in fact, two commutators on one shaft. The magnetic field is set up axially by two coils, one at each end of the shaft, the complete magnetic circuit being made by means of a cylindrical consequent pole surrounding the shaft and projecting between the two commutators. There are thus two complete magnetic circuits, the lines of force passing through the inductors axially and in opposite directions. When the commutators are revolved electromotive forces are set up radially in the inductor bars, in one set acting inwardly and in the other outwardly. By means of brushes pressing upon the outer surfaces of these bars currents may be drawn off. Thus far the machine is analogous to the recent direct-current homopolar machine referred to above, except that it does not make use of collector rings. By connecting the different pairs of brushes in series the electromotive forces may be added together, and any value desired, within limits, be obtained.

So far the only radical change in the machine from the older type of homopolar dynamo is the abandoning of slip rings and making the inductors themselves act as commutator bars. The machine could be used in this way to produce a direct current, or it may be used, as intended, to give an alternating current, if the exciting current be alternating. In this particular machine it is proposed to operate it in this way, the current for the fields being drawn from an alternator having a low periodicity.

The particular feature of this machine which is thought to be advantageous is the independence of the frequency developed of its speed. It is therefore thought to be suitable for driving by steam turbines, thus enabling advantage to be taken of the high speed and yet a low frequency to be produced. Moreover, with but one such machine, hunting of the engine would not affect the operation of the station, and if all the generators running in parallel are supplied from the same source of exciting current, there will be no possibility of getting out of phase, although speed variations will, of course, cause voltage changes. Whether this advantage is enough to compensate for the disadvantages which must be involved in the type of construction adopted remains to be seen. One would expect the generator to spark considerably under load, but it is said that this is not the case. Then, again, the homopolar design is objectionable because of the serious armature reaction, although this may be largely compensated for by a proper arrangement of the brush connectors. Another peculiarity of the machine is the ability to regulate the voltage independently of the exciting current by simply cutting out one or more pairs of brushes.

It would be interesting to see how a machine constructed in this way will behave, as it is such a complete revolution of our ordinary practice. Heretofore the exciter has been a direct-current machine. Here it is an alternator, and the alternator itself is little more than a double iron commutator revolving in the only type of field construction which makes possible a direct current without the use of a commutator. It would be difficult to imagine a more thorough mixing up of the parts of an alternating-current generating system.

ELECTRIC POWER AND WOOD PULP.

Wood pulp is to be more closely associated with the electric development and transmission of water power. This is because pulp-making machinery is suited to form a large load on electric transmission lines and because the manufacture of wood pulp may readily be combined with the development of electric energy in a single plant. More than this, large quantities of pulp wood are produced not far from the sites of hydroelectric plants. Pulp requires a large amount of power for its manufacture, and the wood for this purpose is often transported fifty or 100 miles to points where cheap power is available. By transmitting electric energy to points where the pulp wood is produced, a material saving in the cost of transportation may be made.

One of the most important financial problems connected with the electric development and transmission of water power is to find a fairly constant load during as many hours as possible per day, and this problem can be solved by combining the development of electric energy for general transmission and distribution with the manufacture of wood pulp in a single plant.

Wood pulp is especially adapted for manufacture at an electric generating station by reason of the fact that the part of the process where most of the power is required may be carried on intermittently without much disadvantage, and may continue during either few or many hours per day, as desired. This same fact makes machinery for the manufacture of wood pulp a desirable load for electric transmission systems, because the operation of this machinery can be so regulated as to absorb a large power when most other users of electric energy want but little, if some inducement is offered in the way of low rates.

In that part of pulp manufacture where most of the power is required, that is, in grinding up the logs, the cost of labor is quite small in comparison with the other items, and this makes it the more easy to provide for intermittent work. Some idea of the loads to be met in the production of wood pulp may be gathered from the fact that a pulp mill requires ninety to 100 horse-power per ton of wood pulp made per day, and of this power about ninety per cent is used in the grinders. In these grinders the short logs, usually of spruce and two feet long by six to ten inches in diameter, are forced end on to revolving stones by hydraulic pressure, and the pulp thus made is carried away by a stream of water that flows over the stones. Grinders are usually direct-connected to the horizontal shafts of turbine water-wheels, and the same method of connection can be conveniently

followed where pulp grinders are driven by electric motors. Where a pulp mill is operated by a local water power the grinding machines are seldom or never connected to electric motors because of the investment that would be necessary in generators and motors of the large powers involved, but electric drive is sometimes applied to the other parts of the pulp-making machinery. An example along this line may be noted at Millinocket, Me., where a pulp and paper mill, with turbine wheels of 15,600 horsepower driving forty-eight grinders, has twenty-five electric motors of 3,690 aggregate horse-power connected to other parts of the machinery and supplied with current from generators in the same plant. If the pulp mill, or, at least, its grinders, are operated with transmitted electric power, the motors will naturally be direct-connected to the grinder shafts, and this has been done at the mill in Norfolk, N. Y., where a 1,000-horse-power, 2,080-volt, three-phase, twenty-five-cycle induction motor, operating at 214 revolutions per minute, is coupled to four pulp grinders, two on each end of its shaft. This motor is started with the aid of an external resistance connected with the rotor windings through collector rings. Current for the motor is transmitted over a circuit of aluminum cables twelve miles long at 22,000 volts, and is reduced to 2,080 volts in a transformer house near the mill. Transmissions for pulp grinding seem sure to multiply, and it will no doubt be found that power can be supplied at very low rates for this purpose, if taken at those times in each twenty-four hours when other electric loads are light. Perhaps an even more important place for pulp-making machinery will prove to be at the electric water power station rather than on the transmission line. Such a combination at the electric power-house will not only ensure a high load-factor for the water-wheels in many cases, but will make it possible to utilize large volumes of water that would otherwise go to waste during much of the year. An existing plant that supplies all the energy for an electric transmission system and also manufactures wood pulp illustrates the proposition just stated. This plant has the entire flow of the river on which it is located, and this flow varies between 600 and 2,000 cubic feet of water per second. A large storage capacity in lakes along the upper part of this river explains its small variation of discharge in comparison with many other streams. The canal that diverts water from the river and brings it to the station is about one-half mile long and is designed to carry the larger discharge rate just named. During about nine months of each year the river discharges as much as 1,200 cubic feet of water per second, and the flow reaches 1,800 feet per second for about one-half of the year. In the station operated by the water of this river there are turbine wheels of about 13,000 horse-power total capacity, and when fully loaded they pass some 1,900 cubic feet of water per second. Of this entire turbine capacity about thirty per cent is required by the electric generators at full load, and the remaining seventy per cent is absorbed by the pulp-making machinery. When the river discharge is down to its low rate of 600 cubic feet per second the electric generators require nearly all of the water during the hours of full load, but even then the pulp machines get a large part of the entire daily flow. If 1,200 feet of water per second are available, the pulp machinery works at one-half to full capacity, according to the electric load.

THE CADMIUM CELL.

The newest information about the cadmium standard cell was given by Dr. George A. Hulett at the recent meeting of the American Electrochemical Society at Ithaca, N. Y. The previous work with this standard has inspired an unusual amount of confidence in its reliability, particularly in this country; but even abroad encouraging reports were made, so much so that at the recent preliminary conference on international standardization it was resolved that this cell be recommended as the standard of electromotive force. Unfortunately, Dr. Hulett's recent work has brought to light a new condition, which, for the present at least, casts suspicion upon the cell. Having set up some new cells according to methods which he and Dr. Carhart had laid down, he was disagreeably surprised to find that they apparently gave values too high. Seeking for the cause, he compared the new cells with Clark cells, the original comparison having been made with the older cadmium cells. The result showed that, assuming that the Clark cells had not changed, the new cadmium cells gave values agreeing remarkably with the original values of the older cadmium cells. This seemed to show conclusively that it was the old cells that were at fault, and not the new, and that during the several years since they had been made the electromotive force had fallen.

This drifting of the electromotive force indicated instability somewhere, and this was finally located at the cadmium sulphate end of the cell. Dr. Hulett found that by agitating this part of the cell for some time the difference in potential could be increased considerably, and values about 0.015 of a volt higher than assumed to be the true value of the cell could be obtained. As the trouble thus seems to have been located definitely, it remains to prepare the cadmium sulphate in such a way as to obtain stability at once, otherwise the cell will have to be modified.

These results do not finally condemn the cell as a standard; they merely show that the present way of putting it together or preparing the materials must be modified. It is rather surprising that in spite of the instability of the cell it has been reproduced so accurately. Dr. Carhart, Dr. Hulett and others have made up many cells from various supplies of material and have secured remarkable agreement between them. That this has been possible, even if the resulting cells were unstable, holds out good hope that before long the cause of the drifting will be detected and eliminated. It would be well to have some of the older sets of cadmium cells recompared with other standards so as to determine any change. Previous reports as to the constancy of these cells were very favorable.

The cadmium cell as a standard has an important advantage over the Clark cell in that its temperature coefficient is much less. There is also an incidental advantage in that the electromotive force is near unity. It will be remembered that the earlier forms of Clark cell also showed a certain instability, which was finally eliminated. We have no doubt that the students of the cadmium cell will be equally successful, and that, we hope, before long.

American Electrochemical Society.

Ninth General Meeting Held at Ithaca, N. Y., May 1, 2 and 3, 1906.

THE ninth general meeting of the American Electrochemical Society was called to order in Morse Hall, the chemical laboratory of Cornell University, Ithaca, N. Y., on Tuesday morning, May 1, by President Wilder D. Bancroft, who introduced Dr. J. J. Schurman, president of Cornell University. President Schurman welcomed the society warmly, saying that since Cornell University not only teaches the humanities and science, but gives particular attention to instruction in the applied sciences and engineering that it forms a fitting place for a meeting of the society, which is itself devoted to research work and to application. President Schurman assured the members of the society of the earnestness of his welcome, and put at their disposal all the facilities of the university.

President Bancroft, on behalf of the society, thanked President Schurman.

The reports of officers were received. Those of the treasurer and secretary were not presented, as they will be printed and distributed. The report of the tellers on the recent election resulted in the following officers being declared elected for the ensuing year:

President—Mr. Carl Hering, Philadelphia, Pa.

Vice-presidents—Messrs. S. P. Sadtler, Philadelphia, Pa.; J. W. Richards, South Bethlehem, Pa.; S. Reber, Washington, D. C.

Secretary—S. S. Sadtler.

Treasurer—P. G. Salom.

Managers—Messrs. C. J. Reed, Philadelphia, Pa.; C. F. Burgess, Madison, Wis.; E. G. Acheson, Niagara Falls, N. Y.

The next meeting of the society will be held during the latter part of September in New York city.

The president then called upon Dr. W. H. Walker, Boston, Mass., for his paper, "An Instructive Laboratory Experiment in Applied Electrochemistry." Dr. Walker pointed out the desirable features of such experiments. The process which is to be studied must be one which is adapted to reproduction on a laboratory scale. The raw materials and the apparatus for the experiment must not be expensive. The experiment should be one that admits of theoretical discussion, and it must admit of reasonably accurate work. Finally, it must be given an economic setting. The particular process which the author discussed in his paper is the preparation of bleach from brine. A simple apparatus consists of a graphite crucible, which is used as the anode, and a cathode consisting of a piece of hard rubber shaped like an inverted U, upon which is placed copper wire. This electrode is rotated. The experiment is then conducted to determine the relation between the cost of the bleaching solution, the cost of salt and of power, and the concentration of chlorine in the bleach. A fixed concentration of brine is selected, and the students are required to run a series of experiments with a given current density to determine the efficiency of the process for different concentrations of chlorine. From the data the cost of the bleaching solution, when diluted so as to give a definite concentration of chlorine, is determined for the different concentrations in the electrolysis solution, and from these results the cost of the bleaching solution is determined for each run. In this way the most economical concentration of chlorine can be determined. A second group of students can investigate the effect of current density on the cost of the bleach, and a third set the effect of varying the concentration of the original brine. When these results are all plotted together the method of conducting the experiment which is the most economical becomes evident, as well as how variations in any one of the factors will affect the final result.

The discussion of this paper turned upon the excellence of the method for holding the students' attention and for getting results of actual value, Dr. J. W. Richards stating that he had been using it in his own classes.

The second paper, entitled "Some Principles of Resistor Furnace Design," was read by the author, Mr. C. L. Collins, 2d, of Niagara Falls, N. Y. The treatment of this subject was purely analytical, and was limited to furnaces of the intermittent type, in which the resistor is not the material to be treated. Two assumptions were made—first, that the heat is generated in the resistor alone, no leakage of current through the material taking place; second, that the flow of heat follows the well-known laws of heat conductivity. In such a furnace there are two limiting temperatures—the lower one, at which production begins; and the upper one, at which decomposition of the product takes place. As the furnace heats up the temperature rises, and at some time the inner layer of material to be treated is raised to the temperature at which the reaction sought takes place. This temperature then travels outward. The treatment consists in studying the movement outward of the isothermal surface having this temperature. The results of the investigation are that for high thermal efficiency the ratio of the surface of production to the surface of non-production must be high; that the ratio of energy transfer per unit of productive surface must be high; that the lines of heat flow must not be very diverging, and that the outer coverings of the furnace must be poor conductors of heat. Mr. Collins said that all the results were found to agree with those of actual practice, though, of course, the conditions are not as simple as had been assumed.

Replying to several of the questions, the author said that the flow of current through the material, and not through the resistor, did not lower the efficiency of the furnace, tending rather to increase it, since heat was then produced nearer to the material to be transformed. The actual isothermal surfaces found, as nearly as can be judged from the character of the product, agree with those predicted theoretically. There is no tendency for these to diverge upward due to the rise of hot vapors, since the vapors are set free under such pressure that they are expelled equally in all directions. Moreover, the heat insulation of the furnace is usually best at the bottom, and here the layer of material is found thickest. The effect of the terminals, which had not been considered in his paper, is difficult to allow for, but this is more serious with short furnaces.

The paper by Mr. Lamar Lyndon, New York city, entitled "Electrolyte Density in Storage Cells," was presented briefly by Dr. Bancroft. This discusses the effect of the density of the electrolyte on the pores of the battery plates, showing that the thicker the plate the more likely polarization is to take place, and hence the denser should the electrolyte be. Curves were shown demonstrating the effect of varying the electrolyte density on plates of different thicknesses.

Mr. Maximilian Toch, Long Island City, N. Y., discussed "Electrolytic Corrosion of Structural Steel." Mr. Toch has been experimenting with this matter for several years past. His latest work consisted in passing a current between two elec-

trodes of Sheffield steel, first inserted into the ground and then embedded in blocks of concrete of different proportions. A non-corrosive cement was used for this purpose, and in some cases the plates were coated with an insulating paint. Sheffield steel was used because it corrodes easily, and in this way reduces the time required for the experiments. In all cases, except where paint was used, corrosion occurred, but was more severe when the percentage of broken stone in the concrete was high. Where paint was employed it was found that the corrosion did not take place. Painting therefore offers a very complete protection for structural steel of buildings.

Mr. H. Rodman, of Pittsburg, Pa., asked if making the structure of the building the cathode would not prevent corrosion, and Mr. Carl Hering suggested that for this purpose a mass of zinc embedded in the ground and connected electrically to the steel might be used. This is the method used in protecting boilers.

To Dr. Richards' suggestion that galvanizer's dross take the place of zinc, Mr. Hering said that the zinc should be pure.

Mr. Toch called attention to the method of protection which has been adopted for the Pennsylvania Railroad station at Long Island City. Here a small dynamo is used instead of zinc.

The paper on "The Physical Properties of Fused Magnesium Oxide," by Messrs. H. M. Goodwin and R. D. Mailey, both of Boston, Mass., was read in abstract by Dr. W. H. Walker. The object of the investigation was to find a substance suitable for lining vessels in which fused salts are electrolyzed. An arc furnace was employed, and various materials fused in this way. The best results were obtained with fused magnesium oxide. Masses of this material as large as one's fist were obtained. This was quite hard, resembling glazed porcelain. The melting point is approximately 1,920 degrees centigrade, and the resistivity is high. The figures given were not perfectly explicit on this point, but Mr. Hering thought that the resistivity was about 700,000 times that of copper. Impurities in the material are said to influence its character somewhat, and the density varies in different parts of the furnace. The specific gravity of three different samples was 3.485 at nineteen degrees centigrade, 3.562 and 3.493, the latter two being at twenty degrees. The hardness lies between that of apatite and feldspar.

Professor C. F. Burgess presented an abstract of the following three papers: "Cathodic Disintegration of Carbon in a Fused Chloride Electrolyte," by G. I. Kemmerer; "A New Silicide of Molybdenum," by O. P. Watts, and "The Reduction of Metal Sulphides," by O. W. Brown, all of Madison, Wis. The first of these describes experiments undertaken to find the cause of the disintegration of carbon when used as a cathode in fused salts. The disintegration when used as an anode is well known, but the other appears not to have been investigated. Rods of different kinds were used, one being of Acheson graphite, another of arc lamp carbon. The former suffers much less than the latter. It was found that the amount of disintegration is not proportional to the amount of current, but that current density and temperature seem to exert an influence. As the carbon rod corrodes at a rate greater than that calculated from its electrochemical equivalent, there must be a physical disintegration taking place.

The second paper describes what seems to be a new silicide of molybdenum. The author, when attempting to prepare a series of compounds of the metals with both silicon and boron in an electric furnace, found after treatment aggregations of flat, dark crystals with a metallic lustre. Analysis showed these to consist of molybdenum, silicon, iron and boron. Treating them with hydrofluoric acid removed all the iron and some of the silicon. The remainder, while not pure, appears to consist mainly of a silicide of molybdenum having the formula, $MoSi_2$.

The third paper describes an attempt to reduce molybdenite by mixing it with lime and heating it in an electric furnace, and a similar treatment of stibnite. In the first case a complete reduction takes place, and the method is superior to the ordinary roasting process. In the case of the stibnite, while metallic antimony was obtained, the reduction was incomplete.

Referring to Mr. Kemmerer's paper, Mr. J. Forssell, Cleveland, Ohio, pointed out that ordinary carbon consists of coke granules held by some binder. The latter material is a hydrocarbon and more or less porous, and naturally would be affected by the treatment to which it had been subjected. The action need not be electrolytic. The carbon itself may not be affected.

Mr. Edgar A. Ashcroft, of London, England, presented a paper on "The Production of Sodium." Attention was called to the importance of reducing the cost of production below that of the Castner process, which is now generally used. Data were given showing the importance of this industry and its influence on the arts. The author then described a new type of cell which he devised, and has had in operation for some time. This really consists of two cells—one in which the fused sodium chloride is decomposed, the sodium being deposited upon a molten lead cathode, forming an alloy. The alloy is then drawn off into a second vessel, where it is electrolyzed by means of an electrolyte which does not change, such as caustic potash. The first vessel is a pot having an anode of graphite introduced into the centre. It is lined with some resisting material, and at the bottom is the molten lead cathode. The current passes first from the centrally located anode to the cathode, and then around a coil surrounding the cell. This coil sets up a vertical magnetic field in the cell, which, acting upon the current-conducting electrolyte, causes it to revolve and thus keeps it thoroughly stirred. This action also sets the lead into motion, so that the lighter layer of sodium alloy is skimmed off and flows into the next cell through a pipe. This pipe is surrounded by the return pipe containing the lead freed from sodium, so that there is a partial transfer of heat from the alloy to the cooler lead. In the second cell the alloy enters at the bottom and is covered with molten sodium hydroxide. The outer cell is of iron and forms the anode. The cathode is a nickel-plated sphere insulated carefully from the cell itself and placed centrally, the electrical connection passing out through the bottom of the cell. Just above this is placed a coneshaped hood through which a pipe leads out. The metallic sodium which is electrolyzed from the alloy is deposited on the nickel-plated cathode and then detaches itself and floats up into the hood and runs off through the pipe. The two cells may be connected in series, electrically, proper care being taken in proportioning them and the current through each. The principal features of the process seem to be the use of the soluble anode in the second cell, and of the inactive electrolyte. It is said that the cost of this process will vary with that of the power, but will be between five and one-half and nine cents per pound of metallic sodium; while the chloride is secured as a by-product. In the Castner process it is said that the cost varies from ten and one-half to fourteen cents, and that there is no by-product.

Mr. A. Acker, Niagara Falls, N. Y., did not think that the method of stirring the electrolyte would be satisfactory, and that it could be formed better mechanically; that no provision seemed to have been made

to get rid of the crust which forms on the lead cathode. This crust is merely salt containing a greater percentage of impurity, and it causes a great deal of trouble.

Mr. C. F. Carrier, Jr., Syracuse, N. Y., thought that the carrying of the hot alloy from one cell to another would cause a considerable loss. The temperatures, as given by Mr. Ashcroft, seemed too low, at least for the caustic soda cell. The crust referred to by Mr. Acker, he thought, would be fatal to the process.

Mr. Ashcroft, in reply, said that he had a fairly large apparatus in operation, taking 3,000 amperes, for three weeks; that he had encountered some of the difficulties pointed out, but had overcome them.

On Tuesday evening the presidential address was delivered by Dr. Wilder D. Bancroft. The subject was "The Electrochemistry of Chemistry." Dr. Bancroft first pointed out the great assistance which electrolytic methods give to the analytical chemist. He then showed that as important a service can be rendered to the chemical investigator in many cases when the same reactions take place in the electrolytic cell as in the chemical process pure and simple. Cases were cited in which there is evidently no difference between the chemical and the electrochemical reaction. Other cases were mentioned which at first seemed to be different, but, on closer analysis, were found to be the same. Cases were also noted in which the agreement was not so apparent. It was then argued that in those cases where there is no doubt about the similarity of the results that a great deal of time and labor may be saved by employing the electrolytic method. Such a case is the study of the corrosion of metals. The chemical method would be to place the metal in the liquid and let it stand. Under such conditions weeks, possibly months, would be required before any analytical results could be obtained. On the other hand, the same corrosion could be produced by passing an electric current through the apparatus, and the rate at which metal is eaten away could be greatly increased. In this way the time required to get accurate results could be reduced to a few hours. Studies of this kind are being carried on now at various places.

The speaker then called attention to the use of electrical methods in organic chemistry. Until recently synthesis of organic compounds had not been brought about electrically, but within the last year or so it has been found that such reactions can be caused by means of the silent brush discharge. In this way methane and other hydrocarbons had been produced. The kind of discharge, whether it be alternating, intermittent or constant, affects greatly the results. Many reactions of organic chemistry can be brought about. It seems from this that we are getting nearer and nearer to the conditions surrounding plants, so that a vast field has been opened for investigation which promises to lead to many extremely important results.

On Wednesday morning it was announced that the Fresnel prize of $100 had been granted to Mr. Gustave Gin, of Paris, France, and that Mr. A. T. Lincoln, of the University of Illinois, has received $100 for carrying out an investigation of the corrosion of bronzes.

The first paper to be read was by Mr. G. R. White, of Ithaca, N. Y., and was entitled, "Laboratory Resistance Furnaces." Mr. White showed that a small electric furnace suitable for laboratory work is easily constructed, and that in this various materials, such as calcium carbide and carborundum, may be made. He showed samples of these substances which had been made in such a furnace, using only 175 amperes.

Mr. E. A. Sperry, Cleveland, Ohio, in a paper entitled, "Electrochemical Processes as Station Load Equalizers," discussed the opportunity for establishing such industries in connection with central electric stations. The electrochemical and electrometallurgical processes may be made to consume power only during the periods of light load, thus giving the station an excellent load factor. For such an arrangement the cost of the power to the station would be little more than the cost of coal, and therefore it could afford to make very desirable rates. He had investigated the problem in a number of cities, and had found that the central-station managers there were willing to supply the power and would do so at attractive rates. These rates would vary, of course, according to the character of the load, and they might involve the price of coal. The rates which he had secured were in many cases more favorable than those to be had from hydraulic plants. To apply such processes successfully it will be necessary that they be of an intermittent character, but the storage battery might be employed in some cases where no stoppage would be permissible. The author thought that the electrochemist should spare no effort to avail himself of the large equipments now standing in the central stations, which are idle during a considerable portion of the day.

Mr. Carrier did not think that the rates which could be secured in this way would be low enough. He said that in Elmira the best rate which could be obtained for an eighteen-hour day was a little less than one cent per kilowatt-hour.

Mr. Sperry, in reply, said that he had figures ranging from 0.28 cent per kilowatt-hour, corresponding to about $18 per horse-power-year, up to 0.4 cent per kilowatt-hour. He pointed out that 0.31 cent per kilowatt-hour corresponds to about $20 per horse-power-year, the rate at Buffalo for Niagara power. These rates were secured from a number of cities, and among those which he had investigated were Detroit, Cleveland, Buffalo, Brooklyn and New York.

Mr. W. C. Arsem, Schenectady, N. Y., in a paper entitled "The Electric Vacuum Furnace," described a new type of research furnace which he has devised. One difficulty met in the ordinary electric furnace is the limiting temperature at which the crucible will stand up. In the ordinary atmospheric pressure furnace the fusible crucible soon collapses. In the vacuum furnace the only limit is the temperature of the vaporization of carbon. The furnace consists of an air-tight cell having a crucible of carbon or other material placed centrally on a graphite stand. Surrounding the crucible is a helix of graphite formed by sawing a helical slot in a graphite tube. Suitable means of conducting the current to this heater are provided by rods carried through air-tight insulating bushings. Around the heater is placed a radiation screen consisting of a cylindrical double-wall box of graphite filled with loose graphite. This is to cut off the radiation from the outside of the heater, and thus protect the outer parts of the furnace. At the top of the furnace, just over the crucible, is a tube for inspection, which is closed by means of a mica window. The furnace can be placed in a cooling bath when necessary. In using this furnace it was found at first that the Edison effect caused a considerable leakage of current from the heater to the crucible and to the screen. This was stopped by proper insulation. This leakage usually led to the striking of an arc and the destruction of the heater. After insulation the Edison effect caused a current to flow from one end of the heater to the screen and back to the heater at the other end. No difficulty was met in exhausting this furnace and keeping the vacuum down to a fraction of a millimetre, even at the highest temperatures. It was

found that since the furnace was small and was easily protected from radiation, that the temperature attained could be plotted accurately in terms of the energy supply. The equation was logarithmic, and the curve could be plotted easily when one or two points had been determined by molten copper and platinum, or in any other way. The furnace was useful, since it gave entire control of the temperature; it excluded chemically active gases; it could be employed for purifying materials, for reduction, for synthesis, for determining melting points, and in other ways. It has been found that the life of the heater depends upon the temperature. At 2,100 degrees centigrade it seems to be indefinite; at 2,500 degrees it lasts nine hours, and at 2,700 degrees, about three hours. This seems to be the critical temperature. A later type of the furnace had been arranged, in which, by means of an electromagnet, it was possible to cast the fused materials in vacuo.

Mr. B. E. Curry, Ithaca, N. Y., presented a paper entitled "Electrolytic Corrosion of Copper-Tin Alloys." This described the method by which the experiments have been conducted. The alloys, containing different percentages of copper and tin, had been cast, annealed, cleaned and electrolyzed in various solutions. Curves of the results were shown. The current efficiency is practically 100 per cent with pure copper, but it decreases as the different phases of the alloy are reached, finally falling almost to zero in some cases. A further increase in the percentage of tin then causes an increase in the current efficiency sometimes up to 100 per cent again. This action seemed to be characteristic of all the alloys investigated. The low efficiency is due to the presence of certain phases, and is probably caused by the material becoming passive.

Prof. C. F. Burgess presented a paper prepared by himself and Mr. S. G. Engle, of Madison, Wis., entitled "Observations on the Corrosion of Iron by Acids." Several grades of iron had been employed, including electrolytic iron. The corroding mediums were normal solutions of sulphuric and hydrochloric acid made from distilled water and chemically pure acids. The results show that the electrolytic iron is strikingly more affected than any other kind, as it corrodes about six times as rapidly as cast-iron, four times as rapidly as steel, and nearly forty times as rapidly as transformer iron. It was found that when electrolytic iron was heated so as to drive off the occluded hydrogen that it was much better able to resist the corrosion. The conclusions are that the percentage of purity of the material is not the controlling factor in corrosion; that the crystalline and granular structure of the iron seems to affect the rate of corrosion to a marked degree. The rapidity with which the unheated electrolytic iron liberates hydrogen in a dilute acid solution suggests a useful application of this material in the production of hydrogen by replacing zinc, which is now commonly used. Among the advantages of this use of electrolytic iron lie the higher purity of the hydrogen, and the fact that one pound of iron produces sixteen per cent more hydrogen than a pound of zinc. If a sufficient demand for iron for this purpose should arise it could be supplied at a cost materially less than that of zinc. During the earlier part of the work the results seemed to indicate that the presence of small traces of arsenic exerted a marked influence in protecting iron from the corroding action of acids; but later work showed this not to be the case. Mr. Arsem said that he had found that heating the electrolytic iron in vacuo drove off the hydrogen, but the metal was poor, due to the presence of oxide. He thought that probably this oxide had something to do with the corrosion of the material.

Mr. Rodman said that ordinary iron is now being used to produce hydrogen for lead burning. The gas is passed through potassium permanganate, and is thus purified.

A paper entitled "The Development of the Nickel-Plating Industry," by Mr. Isaac Adams, of Cambridge, Mass., in the absence of the author, was read in abstract. It reviews briefly the art for the past fifty years, but concluded with a statement that no advance has been made in the art since 1869-70. This statement was challenged, though no one was able to controvert it.

Dr. Bancroft thought that there was a great opportunity to improve electroplating processes, referring particularly to nickel-plating. The anodes used at the present time contain iron, since the pure nickel becomes passive. The plates are cast, and not rolled. The objection to this is that impurities are introduced into the solution, and the resulting plating rusts easily, turning red, the color being due to the rusting of the iron in the plating itself, and not that which is covered. This could be avoided if a little chloride, such as nickel or ammonium chloride, were added to the solution, for in the presence of the halides nickel does not become passive.

Professor Burgess thought that a chloride solution might give a self-deposit, but Dr. Bancroft replied that only a trace of chloride was needed, and this would not affect the deposit in any way.

A paper by Mr. R. C. Snowdon, Ithaca, N. Y., entitled "Electrolytic Precipitation of Lead from Acetate Solutions," was read. A rotating cathode was used, with a lead anode and a low current density. Good adherent crystalline deposits were secured with a current density of one-half ampere per square decimetre. At high current densities the deposit became flaky. The discussion of this paper turned on the use of colloids producing good deposits, though no explanation of this action could be given. Dr. H. E. Patten, Washington, D. C., thought that surface action might have something to do with it.

A paper by Professor Burgess and Mr. O. P. Watts, on "A Microscopic Study of Electrodeposits," was read by the former. A number of lantern slides were exhibited showing the character of the deposit. When depositing iron, vertical grooves appear on the deposit if the electrolyte be not stirred, due apparently to rising currents of diluter electrolyte. Sections of the deposit showed that it was built up in layers, and that a dividing surface appeared wherever the current had been interrupted or suddenly changed. Curious nodules were formed having generally a more or less spherical shape. These were thought to be due to a deposit of iron on a speck of dirt. A sharp blow of a hammer detached these from the plate, sometimes scaling off the outer surface. Sometimes pitting appeared, due to bubbles attached to the cathode. Boiling the electrolyte and excluding air stopped this action. Good layers of iron one inch thick can be secured, having a good density, with proper care. The formation of the deposit, when examined under the microscope, resembled that of well-known minerals. The best deposits are obtained with a current density of from five to fifteen amperes per square foot.

Dr. G. A. Hulett, Princeton, N. J., in a paper entitled "The Cadmium Standard Cell," gave the results of some of the later work on this standard. A number of new cells were constructed a short time ago, and when compared with the older cells were found to be disappointingly high, the electromotive force being about eleven hundred-thousandths of a volt too great. When, however, compared with the Clark standards, the new cells were found to be almost identical in value with that of the older cadmium cells when first made; and it was concluded that these

old cells had drifted until they had fallen in value from 1.01842 to 1.01832. Endeavor to locate the trouble seemed to show that the cadmium-amalgam-cadmium-sulphate system was unstable. By constructing the cell so that this part could be taken off and rotated, it was found that the value of the cell could be increased considerably. In one case it rose as high as 1.022+ volts. These disappointing results seem to show that the cadmium cell, as at present constructed, is not a system in equilibrium, and is therefore not yet suitable to be accepted as a standard.

Mr. B. E. Curry read a paper entitled "Electrodeposition of Bronze," describing experiments which had been suggested by his work on the corrosion of bronzes. The copper-tin alloys had been used as anodes, and bronze was plated from several solutions. A tartrate solution with a little ammonium oxalate, so as to render it slightly acid, gave the best results. When the anode is rotated a fairly good current efficiency is obtained. The deposit contained more copper than tin. Nor were the proportions of the metals the same as those of the metals in the solution. It was found impossible to get a good deposition of metal containing less than eighty per cent of copper. When attempts were made to go below this, a black deposit took place.

Dr. Bancroft called attention to the fact that this process was not reversible. The corrosion of the anode depends on the concentration of the anion, while the precipitation on the cathode depends on the proportions of metal in the solution.

Mr. G. R. White presented a paper entitled, "Ferromanganese Anodes in Alkaline Solutions," which described a number of experiments made to study the conditions under which potassium permanganate is formed when ferromanganese is used as an anode in a dilute caustic potash solution.

Dr. H. E. Patten presented briefly a paper entitled "The Migration and Flocculation of Colloids Considered as an Absorption Phenomenon." The paper was purely philosophic and brought together certain phenomena without offering any explanation or drawing any hypotheses. It has been shown that actual decomposition can be caused when a solution is filtered under pressure through a porous plug. Further, an electric charge appears under the same conditions. It is also known that colloids migrate when placed in an electric field. These phenomena undoubtedly are closely connected in some way.

Mr. R. von Foregger, Arochar, Staten Island, N. Y., and Mr. G. F. Brindley, Niagara Falls, N. Y., presented a paper entitled "Some Experiments with Fused Sodium Peroxide for the Regeneration of Air in Submarines," which was abstracted briefly by Mr. Sadtler. It described certain experiments when using fused sodium peroxide for regenerating air in enclosed chambers. Experiments were first made with animals, and then with a man. The moisture exhaled from the body acts upon the peroxide, liberating oxygen. This reaction sets free caustic potash, which absorbs the carbon dioxide also given off from the body. The experiments seem to show that the percentage of oxygen in the enclosed chamber remained constant as long as there was any unused peroxide. The percentage of carbon dioxide did not increase, as there is more than enough caustic solution generated to absorb it.

Mr. Ashcroft asked whether the process was entirely cyclic.

Mr. Carrier said that a catalytic agent is necessary when ordinary powdered peroxide is employed for setting free oxygen, and he believed that it was required also with the fused material.

During the discussion a case was mentioned in which a life had been saved by the use of sodium peroxide. The patient had been unconscious for some time, and the heart had stopped beating. No oxygen was handy, but some peroxide was obtained, and oxygen thus generated and applied to the unconscious man. In fifteen minutes he had been brought around.

Mr. G. R. White, in a paper entitled "Alternating Current Electrolysis with Cadmium Electrodes," described some experiments in which electrolysis had been brought about between cadmium electrodes, using alternating currents. Corrosion took place in spots, particularly at the surface of the electrolyte, where it was due possibly to the depolarization of the solution by the air. It was found that the efficiency of the process was too low to be used commercially for producing cadmium sulphide, although efficiencies as high as thirty per cent were obtained. This efficiency is independent of the current strength and of the temperature and of the stirring. It depends almost entirely on the electrode surface.

A paper by Dr. M. Le Blanc, of Karlsruhe, Baden, Germany, entitled "Electrolytic Chromium," was presented in abstract by Mr. Carrier. This was a reply to certain criticisms made of a statement of his in a paper presented at the Boston meeting of the society by Dr. H. R. Carveth and Mr. W. R. Mott, both of Niagara Falls, N. Y. This paper described a method for plating chromium. Dr. Le Blanc did not agree with the conclusions of this paper, and laid stress upon obtaining a thick plating of chromium. He holds that the problem is not yet solved. While the metal may be plated, it comes down in thin leaves which do not adhere, but strip off.

Mr. Carveth, in reply, said that he had not attempted to get any great thickness of metal. He thought that the results mentioned in Dr. Le Blanc's paper really confirm his own work. The chromium deposited in his experiments had been weighed, but as the deposit was not large, a more satisfactory method of determining the quantity had been developed.

Dr. Bancroft held that since a good deposit has been obtained, there should be no difficulty in getting thick coatings by holding the conditions constant. He pointed out that the deposit had been obtained from chromic acid.

Mr. Curry said that he had himself secured good deposits more than one millimetre thick, although he had tried the experiment but two or three times.

A paper by Mr. M. DeK. Thompson, Jr., Boston, Mass., entitled "The Free Energy of Some Halogen and Oxygen Compounds Computed from the Results of Potential Measurements," was abstracted by Dr. W. L. Miller, Toronto, Canada. It described some experiments undertaken to enable the free energy of certain solutions to be computed. The most general conclusion to be drawn from the experiment is stated as follows: the ratios of the free to the total energy of these solid salts, when these energies are referred to those of the elements of the solid state as zero, do not differ from unity by more than seven per cent, except in the single instance of silver iodide. Those present did not seem to agree with the author either as to his results or the reliability of the method employed.

Dr. J. W. Richards, in a paper entitled "The Electrolysis of Caustic Soda," gave a brief historical review of this subject, describing various processes employed and the reaction supposed to take place in them. He pointed out that Sir Humphrey Davy got metallic sodium only when he employed the electric current for fusing as well as for electrolysis.

Mr. Forssell said that during an experiment with an aqueous solution of caustic soda he had found at one time globules of metallic sodium in an aqueous solution of caustic soda which he had been electrolyzing the previous day. Thinking that possibly a coating might have been formed on this which prevented any reaction with

water, he cut the globules, but they did not react. He had not been able to take up the investigation and locate the cause of the phenomenon.

Dr. Patten said that the same thing had been noticed at Wisconsin.

Dr. Richards said that sodium had been plated out from a water solution, and Dr. Patten said the same thing had been done with calcium.

Mr. Ashcroft thought that the caustic solution might have a greater affinity for water than the sodium itself.

Mr. Carrier said that water is always present in the electrolysis of fused salts, since it is formed as a result of electrolysis.

Mr. C. P. Townsend, Washington, D. C., pointed out that in his process of producing sodium he uses an aqueous solution of sodium hydroxide. The conclusion reached seemed to be that the metallic sodium would not react with the water of the caustic solution if it were sufficiently concentrated.

Dr. Patten presented an abstract of a paper by Dr. L. Kahlenberg and Mr. A. S. McDaniel, Madison, Wis., entitled "Differences of Potential Between Manganese and Lead Peroxides and Various Aqueous and Non-Aqueous Solutions." This described a series of measurements of the potential differences between manganese and lead peroxides in various solutions, such as acetone, pyridine, amylamine, when these materials were entirely free of water, and when they contained water in various percentages. The normal calomel electrode was used. The results obtained indicate that the difference of potential between a peroxide electrode and the solution in which it dips is to be ascribed to chemical affinity—that is to say, the chemical strain or potential between electrode and liquid.

A paper contributed by Dr. Henry S. Carhart and Mr. F. W. Willard, Ann Harbor, Mich., was read in abstract by Mr. Sadtler. This described a new electrolyte for the silver coulometer, this being silver perchlorate prepared by adding perchloric acid to silver nitrate. A porous diaphragm is used, for which purpose filter paper is good. The deposit of silver is good, as no crystals are formed.

A paper by Mr. E. S. Shepherd, entitled "Errors in Pyrometry," was presented in abstract by Dr. Bancroft. This calls attention to a possible error in using Seger cones, as no account is taken of the difference in viscosity of the material of which the cone is made, although this must affect the amount of the tip melted. When using thermocouples the couple must be protected from contamination by vapors from the furnace. It must be constructed so that hysteresis or temperature lag will not take place, and the cold junction must be kept at a uniform temperature. It was pointed out that when measuring high temperatures the temperature is apt to be different in different parts of the furnace, and the thermocouple measures it at but one point. Radiation pyrometers are open to two sources of error. The calculation of temperature is based on the assumption of black body radiation. No attempt is made to obtain it in the carbon tube furnace, where there is always a carbon flame present. An error of 200 or 300 degrees may easily occur. These errors may not be so objectionable for commercial work, since what is sought is comparative or uniform temperatures; but for laboratory work and for research they are very serious.

Mr. F. F. Schuetz, of New York city, described the new Bristol pyrometer, pointing out methods of compensating for errors and the general advantages of the device. A number of those present had used this instrument and found it to be accurate and reliable.

After passing the usual resolutions of thanks for courtesies extended to the society, the meeting was declared adjourned.

The social features consisted in visits to various local industries and inspection of the university buildings. On Tuesday afternoon the chemical, physical and engineering laboratories were shown to the members, and Dr. Bancroft described his lecture room switchboard. The lecture room has a well-equipped board, from which any voltage current can be obtained and distributed to various parts of the lecture table. Above the table are two large direct-reading Weston instruments of the station type, which enable currents and voltages of various values to be read easily by the students.

Wednesday afternoon the new physical building, the power plant in the gorge, the hydraulic laboratory, also in the gorge, and the filtration system of the university were visited. In the evening the subscription banquet was held.

Thursday afternoon a visit was paid to the works of the Remington Salt Company, and a lecture by Mr. E. G. Acheson, on "Carborundum, Graphite and Siloxicon," which was delivered to the students of Sibley College, was attended.

Thursday evening a number of members remained over to attend a lecture on "Pure Foods," by Dr. H. W. Wiley, chief chemist, U. S. Department of Agriculture, Washington, D. C.

Annual Meeting of the Municipal League of Indiana.

The sixteenth meeting of the Municipal League of Indiana will be held at Marion, June 12-15. The meeting will be called to order on Tuesday, June 12, at 1.30 P. M., by the president, J. Fred France. Following the invocation by the Rev. William Rainey Bennett, the greeting will be made for the city by Mayor F. W. Swezey. The response for the league will be made by Judge George E. Downey, of Aurora.

In the evening Mayor M. A. Brouse, of Kokomo, will speak upon the subject, "Should Mayors Have Judicial Powers?" The discussion will be led by Mayor Lawrence Becker, of Hammond.

On Wednesday the subject, "Public Sanitation," will be discussed by T. Henry Davis, secretary of the state board of health, Richmond. W. A. McInerry, chairman of the board of public works, South Bend, will talk upon the subject, "Collection and Disposition of Garbage." Mayor C. A. Bookwalter, Indianapolis, will speak upon "Municipal Ownership," the discussion upon which will be led by Mayor C. W. Sherritt, Muncie. "The Most Economical and Satisfactory Plan of Cleaning Streets and Alleys" will be taken up by Dr. M. F. Baldwin, councilman, Marion. The discussion will be led by Mayor John W. Call, Elwood.

A social session will be held on Wednesday evening.

On Thursday City Attorney Finley P. Mount, Crawfordsville, will speak upon the subject, "New Cities-Towns Law." The discussion will be led by Mayor W. J. Hosey, Fort Wayne. In the afternoon a trip to the Soldiers' Home will be made.

At 7.30 P. M. the paper entitled "Proper Method of Making Assessments for Public Improvements" will be delivered by H. H. Wagoner, city engineer, Huntington. James McWeeny, chief of police, South Bend, will speak on the subject, "The Public Officer and his Relation to Society."

On Friday, at 9 A. M., officers will be elected and the next place of meeting selected.

Annual Meeting of the American Institute of Electrical Engineers.

The twenty-third annual meeting of the American Institute of Electrical Engineers will be held in the library of the New York Edison Company, 44 West Twenty-seventh street, New York, on Tuesday, May 15, at 8.15 P. M.

No papers will be read or discussed at this meeting. The secretary will present the annual report of the Board of Directors and the committee of tellers will announce the result of the recent election of officers of the Institute.

Hydroelectric Plant of the City of Drammen, Norway.

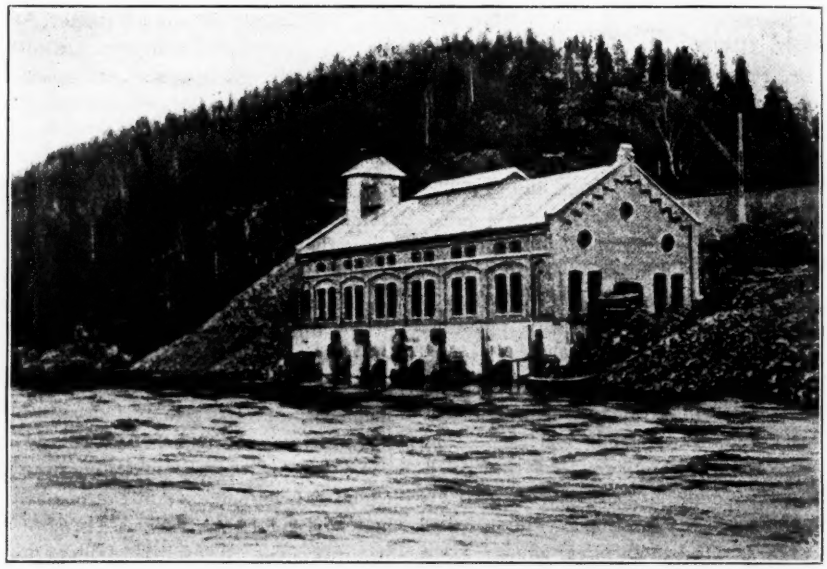
By Franz Koester.

FOR supplying light and power to the city of Drammen and the surrounding country on the Drammen Fjord, located some twenty miles southwest from Christiania, the water of the Storelven was dammed at the waterfall "Gravfos" and utilized in the power-house located at the junction of the Storelven (the upper part of the river Draven) and the Suaramselven, some twenty miles above the city of Drammen. Preliminary to the construction of the power plant it was necessary to build a branch of the Drammen-Randsfjord Railway from Gjeithus and connecting from the end of this branch to the plant by way of a steel bridge over the "Gravfos."

About sixty-five metres (215 feet) above this fall a concrete dam is constructed, with the intake canal at the left of the river bed, provided with six main sluice-gates operated from a gallery above the intake. Connecting with this canal is a tunnel 230 feet long and ten metres (32.8 feet) wide at the bottom with an arched roof cut in the mountain. On account of the softness of the rock it was found necessary to line this tunnel for a distance of twenty-seven metres (226 feet) with brick. This tunnel leads into the collecting basin, which it was also found necessary to line with masonry. The tunnel enters one side of the collecting basin, while on the opposite side are two pressure tunnels, there being space for a third one. One of the ends of the basin is provided with an overflow and sluice-gate to drain the basin in case of an emergency. All sand and gravel carried down to the basin is removed by a sand trap through the overflow channel. The sand-trap gates and also the emergency gates are operated from a point on top of the wall of the basin. Sluice-gates are installed in the pressure tunnels, only one of which being at present in use. These tunnels are four metres (13.12 feet) high and 4.25 metres (13.94 feet) wide and are lined with masonry. Two turbines are connected to this tunnel by means of two short steel branch penstocks, leading from one main penstock, and a third branch penstock leads to the two exciter units.

As the available water supply was thirty cubic millimetres (759 cubic feet) per second with a net fall of 14.5 metres (47.5 feet), a development of 4,400 horse-power was possible. This energy had to be transmitted over a distance of thirty-five kilometres (twenty-one miles) and distributed to two harbor cities spread along the shores of the fjord. The plant was designed to generate three-phase alternating current at a potential of 5,000 volts, which is stepped up to 20,000 volts and then transmitted to the city entrance of Drammen, where this secondary current at 18,000 volts is transformed down to 4,500 volts. From here the current is distributed to a number of smaller transformer substations, where this 4,500 volts is again stepped down to 220 volts, at which potential the consumers are supplied. The feeder systems are installed partly overhead and partly underground. From the foregoing it will be seen that the installation includes a generating station, a step-up transformer system, a long-distance high-tension transmission line, a step-down transformer station, a high-tension distributing system, step-down transformer substations and low-tension distributing systems. The hydraulic plant is designed for four main units and three exciter units, having at one end space for the switchboard and step-up transformers. The total length of the plant is forty-two metres (137.7 feet) and the width sixteen metres (52.4 feet) with an extension on one side containing offices, storerooms, pump room and a repair shop. The entire building up to the generating room floor is of concrete, while the upper part is of brick. The roof trusses are of steel covered with wooden planking and corrugated steel. A fifty-ton overhead crane travels the length of the generating room, but not over the switchboard. As already stated, the plant is designed to accommodate four main units, although only two 900-horse-power units are at present installed and two sixty-six-horse-power exciter units.

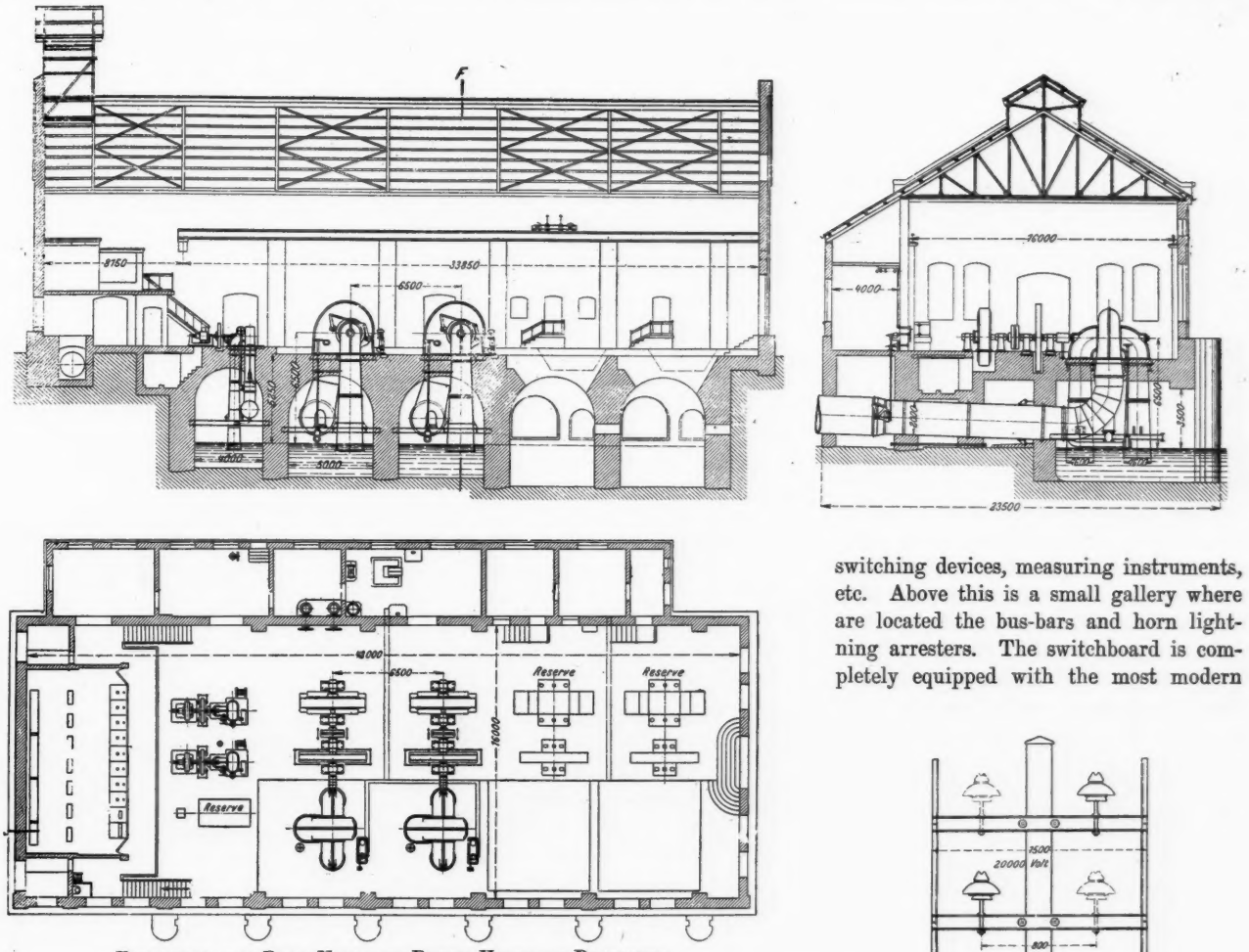
Before entering the building the penstock is divided into two parts, each of 2.1 metres (6.88 feet) diameter, each supplying one of the main 900-horse-power units. In addition to these there is another third branch one metre (3.28 feet) in diameter supplying the exciter units. Each of the main pipes is equipped with a butterfly valve. To operate these butterfly valves electric motors are installed in the pump room, while the valve of the exciter penstock is operated by hand. The main turbines are built on the double-wheel Francis type, making, with a head of 14.5 metres (47.56 feet) and 214 revolutions per minute, 900 effective horse-power. Each turbine unit is provided with a flywheel. Between the turbine and flywheels is a clutch coupling. Each turbine is well provided with hydraulic governing devices. For switching the turbines in multiple the operation of the governor is controlled from the switchboard by an electric motor mounted on the side of the governor.



POWER-HOUSE AT DRAMMEN.

The pressure water needed for the governor is supplied by two seven-horse-power electrically operated pumps installed in the above-mentioned pump room together with the necessary accumulator.

The exciters are also driven by Francis turbines, but of the single-wheel type.



ELEVATION AND PLAN VIEWS OF POWER-HOUSE AT DRAMMEN.

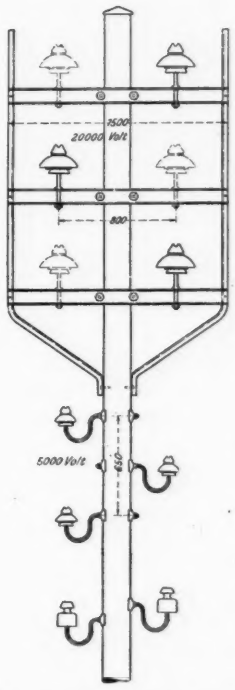
del-Voith system. These turbines are also equipped with hydraulic regulating mechanism, but the pressure, however, is supplied by the head in the penstock, thus avoiding the necessity of pumps, as is the case with the main units. The small turbines, with maximum water supply, have an efficiency of seventy-five per cent, while the main units under the same conditions have the same efficiency. With 0.8 of the water supply the efficiency is seventy-one per cent and with 0.6 seventy per cent.

With a sudden decrease in load from full to no load the variation in speed will not exceed fifteen per cent, while with a variation of twenty-five per cent in load the flywheel holds the variation in speed down to only two per cent.

The alternators are of the Oerlikon type, 750 kilowatts, 5,000 volts, three-phase, fifty cycles, and are coupled to the turbine shafts by means of isolated flexible belt couplings. The magnet frame is in two parts, divided horizontally, with laminated poles bolted to the frame. At full load and cos $\Phi = 1$ the efficiency is ninety-four per cent, while with cos $\Phi = 0.8$ the efficiency is ninety-three per cent. In decreasing from full load to no load the potential increase in the former case is seven per cent and in the latter case fifteen per cent. The above figures allow for the energy of excitation, which at full load is seven kilowatts with cos $\Phi=1$ and thirteen kilowatts with cos $\Phi = 0.8$. The maximum temperature increase after a twenty-four-hour full load run does not exceed forty degrees centigrade. The sixty-four-kilowatt exciter sets are 110-volt, shunt-wound, direct-current generator connected by flexible couplings to the flywheel of the turbine shaft, as already mentioned, and operate at 650 revolutions per minute.

From the generators to the switchboard cables are laid in a tunnel below the floor, three seventy square millimetre iron-bound lead-covered cables leading from each machine.

As already stated, the switchboard is placed on the end wall of the plant and is two stories high, the lower part on the generator room floor level being occupied with the transformers and rheostats, while the upper part is taken up with high-tension (20,000 and 5,000 volt) fuses, switching devices, measuring instruments, etc. Above this is a small gallery where are located the bus-bars and horn lightning arresters. The switchboard is completely equipped with the most modern apparatus and the entire wiring layout made with a view to convenience, flexibility and simplicity. The current from each generator is measured and the total current supplied to the 5,000-volt bus-



ARRANGEMENT OF HIGH-TENSION CONDUCTORS.

bars again measured by recording instruments before feeding the step-up transformers. Current at 20,000 volts is then led out over a line protected by two horn lightning arresters, on each phase arranged in parallel, and also choke coils. In addition to this, a continuous flow of water prevents the potential from rising above 20,000 volts. If the potential exceeds this amount it is grounded through the water.

For switching the generators in parallel a voltmeter switch, a phase voltmeter and synchronizing lamp are provided. A small regulating motor is controlled from the switchboard.

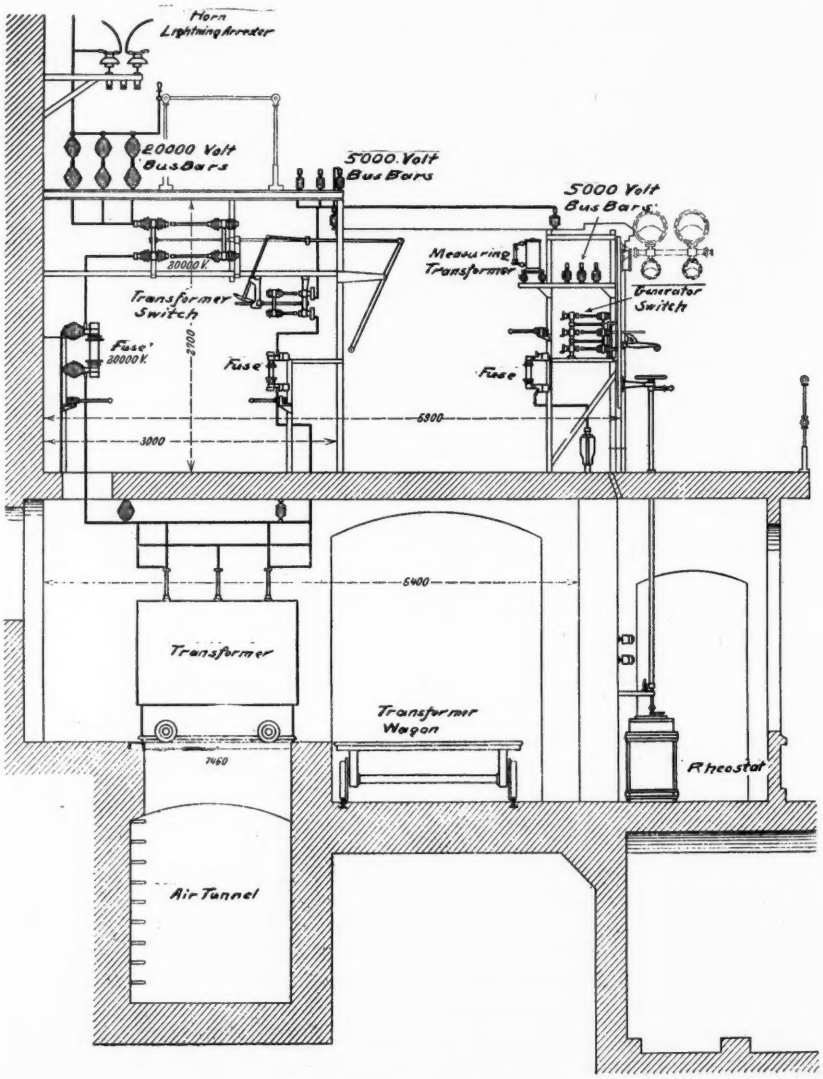
The switchboard is designed to accommodate the complete installation, although at present the apparatus for only two units and the auxiliaries is installed. The board is made of white marble, mounted on an iron frame.

The switch system for the transformers consists of two separate systems, one for 5,000 volts lying in the generator room, and the other for 20,000 volts in the transformer room. The transformers are installed below the switchboard mounted on wheels, so that they may be moved on to low platform cars and carried into the repair shop. An air duct extends under the transformers for ventilation, with a motor-driven fan at the end.

The feeder system is designed to transmit 1,800 horse-power with a drop in potential of eleven per cent. The length of the feeder system is about twenty-one miles and consists of three hard-drawn copper wires with a sectional area of twenty-five square millimetres.

The common method of carrying these wires is on wooden poles having three cross-arms in order to carry six insulators for two systems, three insulators only, however, being at present in place. They are so placed that each cross-arm has one insulator. This is done in order to allow a turn of one-third in the relative position of the feeders, which takes place once in three and one-half miles, so that in the whole run the cables are twisted twice. The poles are placed about 210 feet apart. In crossing streets, streams, etc., protective wire nets are placed under the feeders, so that a broken wire may not drop to the ground.

Wooden poles are used throughout most of the run; lattice-work iron poles, however, are used in several cases. These poles are of the requisite height and are thoroughly creosoted and protected by cast-iron caps. The wires are carried on delta-shaped brown porcelain insulators bolted to the cross-arms. The cross-arms are braced by angle irons so that the wires can not possibly slip off of the cross-arms. Below this high-tension 20,000-volt system for a certain distance is carried the 5,000-volt feeder on porcelain insulators mounted on iron brackets. Twenty-six inches below these are placed the telephone lines. Ten sectional cutouts are installed, enabling the operator to disconnect certain districts. At the crossing, over the railway, a roofed steel structure is provided to carry the feeders.

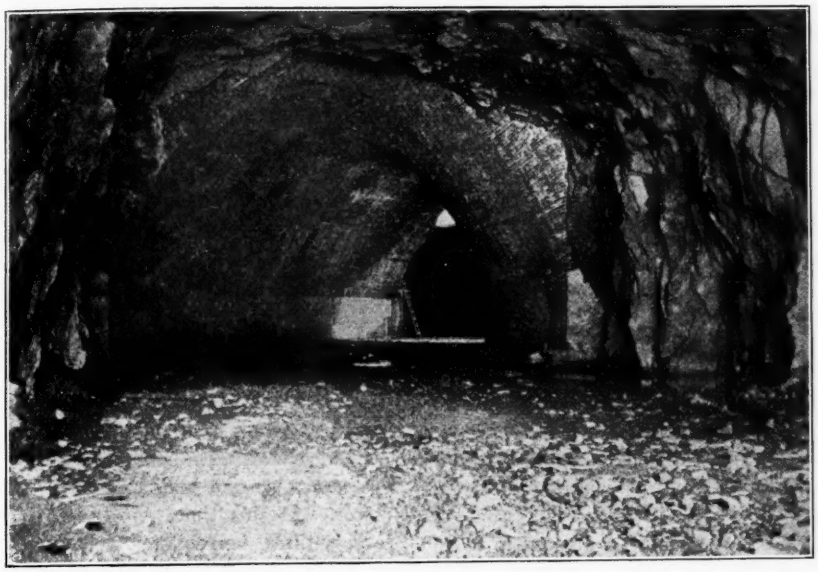


SECTIONAL VIEW OF SWITCHBOARD ARRANGEMENTS OF THE POWER-HOUSE AT DRAMMEN.

There is at present one transformer station for reducing the potential from 18,000 to 4,500 volts. Although the station is designed for the accommodation of six transformers, only two are installed at present. On entering the station the wires are equipped with two parallel switches and horn lightning arresters for each phase. In connection with the above-mentioned overload safety device there is an induction coil in each phase. From the substation three cables and one air line lead out at a potential of 4,500 volts for the high-tension distribution system. A small auxiliary transformer is installed to furnish power at 220 volts for lighting the station and to operate the transformer blower. As the transformer station is a three-story building, the main floor contains the transformers, blower, etc., the second floor the switching system for the outgoing feeders, and the third floor the lightning arresters for the incoming and outgoing feeders. The transformers are of the same design as in the main power-house.

The high-tension distribution system leads to two transformer substations for a certain distance, as previously stated, being carried on the same poles as the high-

tension transmission line. The wire is twenty square millimetres hard-drawn copper, mounted on brown-glazed porcelain delta insulators. The greater part of the high-potential distribution system is that



Entrance of Supply Pressure Tunnel.

carried underground on cables for about eight miles. From the substation two cables run to each of the two halves of the city on the opposite side of the river and fjord. These cables are paper-insulated in a lead sheathing, filled with jute, and iron bound. At the sub-transformer stations the potential is stepped down from 4,500 to 220 volts. There are altogether fourteen transformer stations, twelve of which are in the form of cylindrical steel towers about five and one-half feet in diameter and some twenty feet high, while the two others are of brick. The former stations rest upon solid concrete foundations and are provided with doors to give access to the different apparatus. Special care is taken for good air circulation; the air entering at the bottom rises and is discharged below the top hood.

High-Tension Tower Crossing Tracks.

The high and low-tension systems are, of course, distinctly separate, and so also are the light and power systems. In order to simplify the wiring as much as possible the three high-tension busses, which are of aluminum, are mounted directly on the fuses. On the low-tension side the feeds run down to a three-pole knife switch and to the fuses. Here, also, the busses are mounted directly on the fuses. The iron frame of the stations as well as the transformer frames are positively grounded with a copper wire.

The masonry buildings are made of rough stone and well supplied with natural light and also for air circulation. The wires of the 4,500-volt system enter the station through glass plates, passing through induction spools and fuses to the transformers. The system is protected by three horn lightning arresters. The other equipment is the same as for the iron towers.

The low-tension distributing system consists of overhead air lines and underground cables, the latter being laid in trenches twenty-eight inches deep and covered by tiling. The overhead lines do not run directly from the transformer stations, but are connected from the underground feeds, in which case small iron latticed poles are erected. These poles are surrounded by an iron sheathing six and one-half feet high, provided with a door to give access to the fuses, etc. From the fuses the feeders rise to the top of the pole, which is also surrounded by sheet iron behind which the induction coils are arranged. The lightning arresters are installed outside of this casing. The arresters and towers are grounded by a common copper wire. From these distributing towers the wires lead to the various consumers. The mechanical equipment is supplied by the Drammens Jernstöberi & Mekaniske Vaerksted, of Norway, while the electrical equipment is furnished by the Maschinenfabrik Oerlikon, of Switzerland.

Independent Telephone Franchise Sold for $100,000 in San Francisco.

In a letter written at Oakland, Cal., by John Van Liew, treasurer and auditor of the Empire Construction Company, of California, and also president of the California Independent Telephone Company, to James B. Hoge, president of the National-Interstate Telephone Association, Mr. Van Liew states that five days after the earthquake and fire at San Francisco a franchise for a telephone system was to be sold, and that his company paid $100,000 for it, and that construction will be commenced as soon as material is available.

THE EFFECT OF DAY LOAD ON CENTRAL STATION ECONOMY.[1]

J. P. JONES, CEDAR FALLS, IOWA.

This subject, effect of day load on central station economy, is one that is, or at least should be, of interest to the members of this association, and we will have to consider it sooner or later, for as each year passes we find the different factories and other classes of business as well, are looking into the subject of electricity as a source of power. We find that drug stores, hotels and restaurants want fans to keep their stores and dining rooms cool and also free from flies; while they also find it very handy to have electric lights for general usage on dark days and a constant light in dark store basements. Butcher shops and groceries use the current for the purpose of grinding their sausage and coffee.

Last year I gathered some special data on this subject of day load. I had the man at the station take a reading of the wattmeters at seven in the morning and at six in the evening, but lost most of my material in our fire and explosion of last month, retaining only the readings taken in April, October and the first fifteen days of November, 1905. As we are not, and have not been, running a generating plant in Cedar Falls since the spring of 1903, I have had to take the cost of running as it was prior to January, 1903. We were not running a day current at that time, but the figures will serve as a basis to figure on.

I find that our day load for April, 1905, averaged 150 kilowatt-hours, that of October averaged 178 kilowatt-hours and the first half of November averaged 254 kilowatt-hours per day. In the month of October we had on our circuits sixty-two and two-thirds horse-power in motors, which were placed as follows:

Overall factories	8	Horse-power
Drug stores	1	"
Newspapers	8⅔	"
Rug factory	5	"
Doctors' offices	2	"
Hardware specialty manufacturing company	10	"
Canning factory	27½	"
Residence, washing machine	½	"

In the month of April we had a motor load of twenty-four and five-sixths horse-power.

In the consideration of cost of running a station where the fires are banked in the morning and started up in time to have steam by the time sun is down, we will have the following items to figure:

First: how long the coal that was used to bank in the morning and start up in the evening would run the station carrying the load it would have during the day.

Second: what would be the cost of water, boiler compound, oil, waste, etc.

Third: the salary of the engineer to run the station during the day.

The item, wear and tear of the machinery will not be considered, as that is usually taken into account in fixing the rate charged for current.

We used 175 pounds of coal to bank the fire and about 250 pounds to start up in the evening. That would give 425 pounds to help out the day run. Taking twelve pounds of coal per kilowatt-hour, the 425 pounds would develop thirty-five kilowatt-hours. As I have stated before, the average daily load in April was 150 kilowatt-hours for the time between seven in the morning and six in the evening. The 425 pounds of coal would run about one-fourth of this time, or it would require about 1,700 pounds of coal for the day, which, at $2.00 per ton, would be worth $1.70, this would amount to $51.00 per month.

We can figure that the water, oil, waste, etc., would amount to $2.50 per month.

The engineer's salary would amount to $50.00 per month.

Summing these items up we would have:

Cost of coal for April	$51.00
Cost of water, oil and waste	2.50
Salary of engineer	50.00
Making a total of	$103.50

I found from our ledger of electric accounts that the total receipts for April, 1905, was $66.92. We had some small motors and other appliances, such as electric sad irons, fans, etc., that were on the regular lighting rates, and these would not show on our power bills, also there would be some lights used, so I have placed the amount at $15.00. This will give us a total of $81.92 received against $103.40 cost of running.

Now, taking the same course of figuring for the month of October we will have:

Average kilowatt-hours per day, 178; the 425 pounds of coal would generate about one-fifth of this average day load. It would then take 2,125 pounds of coal to make the day's run, which would cost $2.12. That would mean $63.90 for coal for the month. Taking the same amount as before for water and engineer's salary, we would have a total cost for month of October of $116.60.

The amount received for power during the month of October was $98.70, allowing $20 for lighting we have as total receipts $118.70, against a cost of $116.40.

Taking the first half of November, the average was 254 kilowatt-hours. The coal used in banking and starting up would be about one-seventh of the total amount required for this average day load. This total would be 2,975 pounds, which at $2 per ton would cost $2.97 per day, or $44.55 for the fifteen days. Allowing $1.50 for water and $25 for engineer's salary, the total cost for the one-half month would be $72.05.

One-half the receipts for November power amounted to $45.61. Allowing $25 for lighting, we have as total receipts, for the one-half month, $70.61, against $72.05 cost of running station.

Now this does not make a very good showing, but at this time we were not making the effort to get power business that we would be doing if we were running a station as per the figures just given. As I have stated, the motor load in October was sixty-two and two-thirds horse-power. At this time, April, 1906, it is seventy-three horse-power. Besides, we have a laundry using current for heating flat irons, using about seventy-seven kilowatt-hours per month; a tailor shop using an electric goose; several doctors using current for X-ray coils and cautery needles; dentists using motors for polishing and grinding lathes; a butcher shop with a sausage grinder and a tea store with a coffee grinder. On dark days, arc lamps in the stores are used part of the time, and during the holiday season some of the stores light all day. Also a woodworking factory that uses an electric soldering iron to melt the wax filler.

From what I can see of the conditions in our city I believe that if we were to have a generating station, a day current could be made to pay a reasonable profit.

C. H. WALSH, BURLINGTON, IOWA.

In the design of a central station plant, the one great aim is to attain the highest possible economy in the operation of all departments of that plant.

Boilers, engines, dynamos and distributing systems are so installed, that the maximum assumed load may be carried in an economical way. Economy means not only the saving of so much coal and water, but also the application of the energy derived from these requisites in such a way that the greatest money returns may be obtained from them. Many plants, built originally, perhaps, for street-lighting purposes, or for commercial service from dark to daylight, have extended their scope of operations, adding other departments still, and increasing their revenue. The same is true of plants in the larger cities, where,

[1] A symposium presented before the convention of the Iowa Electrical Association, Des Moines, April 18-19.

although twenty-four hour service was given, the night lighting load was originally the principal source of revenue.

The writer will not go into detail on this subject, the time to work up data and curves for it having been rather too short, but will treat it rather generally. It is a subject that, although not new to any of us, will still bear considerable discussion, and if this can be started the object of the convention, the interchange of ideas, will be more nearly attained.

The purpose of day load is, naturally, to be able to use apparatus installed to meet peak conditions, at times when the load curve approaches the minimum, making this curve come as nearly as possible to the straight line for the twenty-four hours, and making the machinery help pay fixed charges on the plant, at times where otherwise it would be idle. These fixed charges will naturally be increased to some extent by the addition of the necessary apparatus and means of distributing day load, and the extra labor necessary to handle it will need to be considered, still it is a fact that these items are but a small proportion, ordinarily, of the possible increase in revenue.

Day load may be added in a variety of ways and each class of day service operates in a rather different way, in its effect on central station operation, as well as its economy.

Central stations of the later day are generally so built that nearly all classes of electrical service may be furnished from the same source. This applies not only to electrical apparatus but as well to steam-driven machinery, whether turbines or reciprocating engines, and to boilers. All of this apparatus gives the best results at a certain load point, and the more nearly this condition is maintained the greater naturally will be the saving in coal and water, and the greater the returns in money. There are at this day some practical limitations to combined plants, but the efforts of manufacturers and designers will surely remove these in time.

In many cities and towns, where lighting plants have existed for years, the building of electrical street railways has furnished the means for adding one class of day load. However, under present conditions, the nature of the current necessary for railway purposes precludes furnishing it from the customary generators in use for lighting purposes. The boiler plant, of course, need not be changed unless it be to add capacity necessary for large railway units. Where polyphase generators have been used for lighting purposes, one simple way is to drive the railway units by means of synchronous motors, direct connected. Railway load has the disadvantage of great variations, with extreme peaks on top of the lighting peak at certain hours of the day, making it necessary to install other apparatus, such as storage batteries, for instance, to meet these new peak conditions or run the generating machinery under overload conditions.

The usual method of adding day load is by the sale of commercial electric power for operating elevators, pumping plants, factories, small refrigerators, etc., and this class of day load is most profitable, being what is necessary for a central station heating plant, and in itself giving good returns at the station. It is the type of load most easily added to any plant, whether operating single or polyphase alternating or direct current. Many of the plants in the smaller towns still operate their single-phase equipment of former days, and are in good condition to use it to advantage in this day of improved single-phase motors. The single-phase motors now on the market, notably those of the Wagner Company's make, possess all the characteristics of the reliable direct-current series motors, combining great starting torque with low starting current, requiring less in transformer installation and cutting down transformer losses, which on polyphase systems with the necessary two or three transformers for each installation, are a considerable item of the idle load on the plant.

Many plants having polyphase apparatus and distributing systems are also using single-phase motors to good purpose and getting good results.

Although street lighting may have been the original purpose for which a plant was installed, and the commercial business added later, or though the process may have been the reverse, the street-lighting load, though not, strictly speaking, "day load," comes under the same heading in its effect on the station. It tends to broaden the peak, and being in most cases run off the same machinery as commercial lighting, keeps this machinery busy when the commercial lighting peak is off. It has the additional advantage of being a straight line load, with no peaks of its own.

A large number of the smaller stations, and some of the larger ones, have in late years added another and very profitable source of revenue from day load, *viz.*, central station heating, made possible through the sale of commercial power in some form or other. A heating system as an adjunct to a central station not having sufficient exhaust steam to furnish such heating, and depending in a large measure on live steam during the day time, would certainly be a doubtful proposition. The steam necessary for the business in such a case is no longer a byproduct. But with sufficient day load on engines to furnish the necessary exhaust steam, the proposition becomes one of certain economy, enabling current to be sold to day customers at a rate which will be an inducement for them to take it and still return a profit. As a matter of fact, the money cleared from the sale of the heating itself is in most cases sufficient to pay for all or nearly all of the total annual coal bill for the plant. In one case coming under the knowledge of the writer the steam-heating business paid for about seventy per cent of the total coal bill, the plant selling exhaust steam direct, carrying back pressure averaging fourteen pounds and losing the condensation. In another case, that of a hot-water system, the heating more than paid for the total coal bill. Rates for electrical service were made in some cases as low as one and one-half cents per kilowatt-hour, the customer keeping off the peak. It would not be possible to do this if coal had to be charged against the production of the current or extra capacity installed. We have been told by some heating promoters that electric current can be sold cheaply because of the revenue from the steam, and it has also been argued that the heating could be sold cheaply because the steam is a byproduct. It will not do to cut corners both ways. One or the other must be sold at a profitable rate. When a station carrying railway load, run, as ordinarily, on separate unit, sells exhaust heating by direct steam, the effect of the changing railway load, and consequently the changing back pressure, may be enough to affect the regulation of units on lighting service, where these are running fairly well loaded and at an economical point, supposedly. The excessive back pressure necessary for most plants selling steam direct is an objection not possessed by the hot-water-heating system, and the profit from the latter should be correspondingly greater.

In conclusion the writer wishes to say that in his belief the beneficial effect of day load on station economy is admitted by all, and that very little of anything new can be said on the subject. The writer has not attempted this, but yet believes that there is ample ground for dis-

cussion of points that have been mentioned.

W. J. GREENE, CEDAR RAPIDS, IOWA.

The question of furnishing twenty-four-hour service is one to which every central station, not furnishing such service, should give careful consideration. To properly occupy its field, every central station should give continuous service. I can not give data to show what the effect of a day load on station economy would be in cities of less than 15,000 population, but data secured from the operation of the Cedar Rapids plant in 1890-91 and 1892, although meagre as to kilowatt-hour output, pounds of coal per kilowatt-hour, etc., may be of value. Smaller plants giving twenty-four-hour service can possibly substantiate this data and the conclusions drawn therefrom.

Day service was commenced July 1, 1891.

Considering the subject only in relation to its effect on power-house expenses, our records show that in the three months following the commencement of day service, the items of wages, fuel, oil and waste, the principal expense accounts affected, were increased $60 per month over the three preceding months.

Considering the subject in relation to its effect on the entire plant expense, interest and depreciation excepted—expenses for the above comparative periods were increased $103 per month.

Considering the subject in relation to its effect on the entire station economy or increasing the net earnings per dollar invested, and this, as I understand the question, is the real essence of the topic, our old records will still throw a little light on the phase of the subject. The revenue from power service for the first three months was $34, $81 and $104, respectively, or an average of $73 per month, a little more than offsetting the increased power-house expenses. No material increase could be looked for in revenue from lights during this period, because of the summer months, the short time of operation and the fact that satisfactory alternating-current fan motors, irons, etc., were not procurable. The records show that the increase in lighting revenue for this period over the corresponding period of the year before was practically the same as the increase for the three months prior to such service over the corresponding months of the year before. Comparing corresponding periods between 1890 and 1891, a year's operation without the benefit of the day service, the light revenue increased twenty per cent; the entire operating expenses increased twenty-three per cent, and the net revenue increased twenty-four per cent. Comparing 1891 with 1892, after one year's day load operation, the light revenue increased thirty-two and one-half per cent; net revenue fifty-nine per cent, expenses thirty-one per cent, showing an increase of nearly 150 per cent in net revenue over what could have been expected without the day service.

Our records are of no value, for present-day consideration, in determining the increased investment due to day service; because we were compelled to put in separate generators and circuits for the power service. If a plant is properly equipped for present all-night loads, the immediate extra investment for starting a day load would be almost negligible. If increases are afterward required for meeting increased demands, they should be welcomed, but have no bearings on the subject under consideration.

It must be remembered that this data is from operative conditions existing fifteen years ago. Advancement in the art of central station operation and management would enable any plant at this time to do much better, and taking these facts into consideration, I believe the above percentages are applicable and will give conservative results if used in estimating the effect of a day service on any plant. There are many uses to which electricity can now be applied that were not available fifteen years ago. Cities in which no gas plants are installed give unlimited possibilities for heating devices, a field that is slow to open up in gas-covered cities. Look at this partial list of utensils, now a commercial commodity: flat-irons, curling-irons, cigar-lighters, hot-water urns, coffee-pots, waffle-irons, hot-plates and broilers, oyster-cookers and stewers, toasters, chafing dishes, cereal-cookers, water-boilers, baking and warming-ovens, heating pads, glue pots and soldering-irons. Then look at the special uses to which electricity can now be applied for power purposes that were not available fifteen years ago: alternating-current fan motors; sewing machine motors, bellows, automobile charging sets, etc.; and the effect of a day service in increasing light consumption must not be overlooked. Consumers will be secured as a result of continuous service that could not otherwise be had. As soon as a day circuit is established, a demand will be found for day lighting in basements, halls, closets, bank vaults and parts of stores. We find that stores use current more and more in the day time, as a result of the darkening of rooms by window decoration.

Before any plant undertakes a day service, the economical equipment of the power-house and the distributive system, and rates should be carefully gone over. With suitable equipment the increase in coal burned per kilowatt-hour should be slight, because the coal used in banking and starting fires will go far toward taking care of the dead day load. If the plant is amply and economically equipped for the night run, very little extra investment would be required for day service, possibly an additional boiler in order to provide sufficient time for cleaning. If the plant equipment is not properly arranged for the night run it should be remodeled, but this cost could not properly be charged to a day service. The saving during the night should compensate for the cost of remodeling. Another important investment that should be made before undertaking day service is to install watt meters at switchboard and on all consumers. Here again is an equipment that should be had anyway, and is not chargeable to day service. Stations that are now selling entirely or largely without meters might find the inauguration of a day service a good reason for immediately changing all consumers to meters.

The more I consider the subject, the more I am convinced that few plants are too small to establish a day service. It might be a drag for a few months, but look at the possibilities for increasing business and, above all, completely occupying the field. After the drag period is once passed, increase in day load will rapidly reduce the cost of station expenses per unit generated. I have an instance in which station out-put was increased 264 per cent, and expenses were increased only twenty-seven per cent, cutting the cost per unit generated fifty-two per cent.

The only conclusion that can be reached is that the effect of a day load in station economy will be to increase the efficiency by increasing net revenue at a greater rate per dollar invested than can be accomplished in any other way. Keep your plant busy every hour in the year; interest, depreciation and taxes are never idle.

Electrification of the London, Brighton & South Coast Railway.

It is announced that a contract has been entered into by the London Electric Supply Corporation for the supply of power to the London, Brighton & South Coast Railway for working the trains on its South London line between London Bridge and Victoria for a period of seven years. This contract was referred to in the report of the proceedings at the annual meeting as well as the new contract entered into with the London County Council for a period of three years, for the supply of power to the council's tramways, to commence at the expiration of the existing agreement.

The Second Annual Convention of the Southwestern Electrical and Gas Association.

Final arrangements have been completed for the annual convention of the Southwestern Electrical and Gas Association, which is to be held at Galveston, May 16, 17 and 18. A very interesting and attractive programme has been prepared by the committee, and the papers which will be presented are unusually instructive and well prepared.

Mr. Stichter, editor of the "Question Box," reports that although this is the first year of the inauguration of this feature, widespread interest has been shown by the members of the association and outside electrical, gas and telephone companies, and that he has received a liberal number of questions concerning each branch of the association, the answers and discussion of which brought forth at the convention will be both valuable and interesting.

A pleasing entertainment has also been provided for each day of the convention, including a tour of inspection of the grade raising work of the city, the sea wall and the dredging apparatus used in connection therewith, the latter having been retained through the courtesy of the engineers in charge of the work, so that its operation might be seen by those present at the convention. There will also be an excursion down the harbor and to the jetties, and at all times during the convention the fine surf bathing and fish dinners for which Galveston is so famous will be available for those wishing to partake and will be worth going many miles to enjoy. Additional entertaining features will be prepared for the ladies present.

On the night of May 17 the Sons of Jove will hold a grand rejuvenation and initiate new members into the mystic orders of the association, and will have a parade which is to be more spectacular than on any previous occasion.

The Galveston Business League's rooms in the Tremount Hotel have been selected as headquarters of the convention, and many applications for reservation of rooms have already been received. Special prices have been obtained and those expecting to attend it are requested to make application for accommodations, stating number of rooms, whether with or without bath. These should be addressed to Mr. H. S. Cooper, chairman of the entertainment committee, care of the Galveston Electric Company, so that all may be provided for and avoid confusion and misunderstandings upon arrival. Arrangements are being made by the committee for special rates on all railroads.

Those in charge of the convention have used every effort to make it a great success, and it is fully expected that there will be a large attendance and that the convention will surpass any yet held by the association.

The members have extended invitations to representatives of all gas, electrical, telephone or telegraph non-member companies to attend the convention.

The Electrical Contractors' Association will also hold its annual convention on the same dates, a large attendance to which is also promised.

Advances in Wireless Telegraphy.

At a meeting of the Royal Society held last month, Mr. G. Marconi presented a paper dealing with the advances in wireless telegraphy, and with the methods whereby the radiation of electric waves may be mainly confined to certain directions. As was only to be expected, the views of so eminent an authority of the subject were looked forward to with a great deal of interest, and the paper in every way fulfilled the expectations raised. Mr. Marconi communicated the results observed by the use of a straight horizontal conductor placed at a comparatively small distance above the surface of the ground or water, instead of the usual vertical antenna employed as radiator or absorber, in wireless telegraphic stations. When an insulated horizontal wire was connected at one end to a sphere of a spark gap, the other sphere of which was earthed, and sparks were caused to pass between the spheres, the radiations emitted reached a maximum in the vertical plane of the horizontal wire, and proceeded principally from the end which was connected to the spark gap, while the radiation was *nil*, or reached a minimum, in directions which were approximately 100 degrees from the direction in which the maximum effect occurred. Any horizontal conductor of sufficient length placed upon or at a short distance above the surface of the ground, and connected at one end through a suitable detector to earth, would receive with maximum efficiency only when the transmitter was situated in the vertical plane of the horizontal receiving conductors, and in such a direction that the end connected to the detector and to the ground was pointed toward the transmitting station. If, therefore, such a horizontal conductor was swiveled about its earthed end in a horizontal plane, the bearing or direction of any transmitting station within range of the receiver would be ascertained. He had carried out a number of tests with transmitters and receivers having radiating or receiving antennæ or conductors arranged in various ways. At Clifden, Connemara, Ireland, by means of a horizontal conductor, 230 metres in length, laid on the ground and connected at one end to a magnetic receiver and to earth, it was possible to receive with clearness and distinctness all the signals transmitted from the Poldhu station (situated 500 kilometres distant), provided that the free end of the conductor pointed directly away from the direction of Poldhu. No signals could be received if the horizontal wire at Clifden made an angle of more than thirty-five degrees with the line of direction of Poldhu. The signals from the Admiralty station at Scilly could be received at Mullion, Cornwall (distance about eighty-five kilometres), by means of a horizontal wire, fifty metres in length, two metres above ground, provided the wire was placed in a radial position with respect to the sending station and with its free end pointed away from it. But it was unreceptive if placed so as to make an angle of more than twenty degrees with the line of direction of the station at Scilly. He had noticed that the most advantageous length of the receiving horizontal wires, in order to obtain results at maximum distances, was about one-fifth of the length of the transmitted wave, if the wires were placed at a distance above the ground, but the receiving wires should be shorter if placed on the ground. When using horizontal receiving wires, he had often noticed that the natural electrical perturbations of the atmosphere or stray electric waves, which were generally prevalent during the summer, appeared to proceed from certain definite directions, which varied from time to time. It would be exceedingly interesting to investigate whether there existed any relation between the direction of origin of these waves and the known bearing or direction of distant terrestrial or celestial storms from whence these stray electric waves most probably originated. He proposed to carry out some further investigations on the subject. —*Electrical Engineer*, London.

For a Wireless Telegraph Conference.

The German government has fixed June 28 as the date for an international wireless telegraph convention, to be held at Berlin. The United States has been asked to participate in this convention, the purpose of which is to make regulations for the control of wireless telegraph systems.

Telephone Rates in New York City.

Some very interesting light was thrown upon the subject of telephone rates in a large city at a recent hearing before the Senate Committee on Miscellaneous Corporations, on Senator Riordan's bill, at Albany, N. Y. This bill was entitled "An Act to Amend the Transportation Corporation Law Relating to the Transmission of Despatches." The bill had for its purpose the reduction of telephone charges in New York city and between the various boroughs of Greater New York. The following extracts are taken from the presentation of facts which was made by Mr. Union N. Bethell, vice-president and general manager of the New York Telephone Company:

In his preliminary address to the committee Mr. Bethell said, in part:

"A member of his cabinet was delegated by President Roosevelt in 1905 to consider the question of telephone rates in Washington, with special reference to the interests of the national government, and the message rate plan, considered from the standpoint of a large user, was unqualifiedly endorsed, the official report on the subject containing these words:

"'Under the measured service system, the telephone arrangements of the departments can be extended indefinitely and economically wherever a saving in time of officials and clerks indicates the proper use of the telephone. Under the flat rate system the number of stations and the convenience of the system could only be economically extended where enough business could be foreseen to utilize the capacity of the instrument.'

"Consideration of these facts as applied to the telephone service of the government in Washington, as well as the consideration of the general telephone practice, left no room for doubt that the measured service system was that suited to the interests and needs of the government, and that a flat rate charge would not allow of the economies desired nor would it permit of the maximum of an efficient telephone service.

"Therefore, from the standpoint of large users, as well as from that of small users, the message rate system is endorsed."

After a considerable explanation of minor points the following interesting discussion ensued:

Mr. Bethell—So much is being said at the present time respecting the over capitalization of public service corporations and the misuse of franchises that I wish to say very clearly and emphatically that the New York Telephone Company does not carry one dollar in its capitalization account representing its franchises. It has refrained from capitalizing its franchises not only because it believes this would be absolutely wrong and unjust, but also because from the standpoint of its own interest it would be shortsighted and unwise. In fact, it believes it to be good business to maintain a just and conservative capitalization based upon a legitimate and fair valuation of its property not including franchises.

Senator Cassidy—You say you don't capitalize them?

Mr. Bethell—We don't capitalize them.

Senator Cassidy—The state capitalizes them.

Mr. Bethell—Yes, the state capitalizes them for the purposes of taxation. We pay taxes upon them, but, as usual with corporations paying franchise taxes, we charge those taxes in our expense account. Thus these taxes are indirectly borne by the public, and we do not think it proper to capitalize the franchises and write them into our asset account, and by paying interest or dividends on them place an additional burden on the public. Franchises are property, and can not be taken from their owners without just compensation and due process of law, and they unquestionably have a distinct value, but the New York Telephone Company has believed and does believe simply as a matter of good business that it should not capitalize its franchises. It never has done it, and it does not carry, as I say, one single dollar in its capital account to-day representing its franchises.

Senator Cassidy—Your percentage of earnings to investment would be greatly reduced if you capitalized them.

Mr. Bethell—If we did capitalize them we could use earnings to distribute among stockholders as dividends instead of giving them to the public in the way of lower rates, but I say that would be improper.

Senator Cassidy—That would reduce your dividend rate, wouldn't it?

Mr. Bethell—If we did capitalize them?

Senator Cassidy—If you distributed the same earnings over a larger capitalization.

Mr. Bethell—Yes, that is true.

Senator Cassidy—So if you did capitalize them you wouldn't be able to declare a dividend of ten per cent?

Mr. Bethell—We don't declare dividends of ten per cent. The net earnings, as certified by the audit company, were approximately ten per cent of the actual and necessary investment. Net earnings must provide not only for a return upon the capital in dividends and interest, but also for contingencies; that is, the surplus and reserves. We do not declare ten per cent dividends.

In general, the policy of the company is to maintain its service at the highest point of efficiency and so adjust its charges from time to time as to limit its earnings, as nearly as possible, to the amount required to meet necessary operating expenses, including, of course, the actual depreciation of its plant, whether due to decay or changes in the art, provide a reasonable reserve or surplus for periods of industrial depression and such contingencies as may arise; and yield a fair return on the actual and necessary investment, not including franchises. The management believes that earnings in excess of the amount so required, if any accrue, should be devoted to expanding and improving the service, bettering the condition of employés and reducing the charges to the public.

The management of the New York Telephone Company recognizes and has always recognized that its duty is not only to the stockholders and the employés, but also to the public. As a public service corporation it is in a sense a trustee for the public, and is subject to the usual obligations of a trustee: first, a fair and honest administration of its trust; and, second, periodical accountings or reports of the results of its administration. That is, not only as a matter of justice to the public, but in its own self-interest. I have pointed out or attempted to point out that there is grave danger of serious injury to the public in attempting to deal with the separate details of a complicated system, like ours especially, on the advice of those who are unfamiliar with the subject, as illustrated in the bill under consideration.

Senator Cassidy—You don't believe the internal affairs of a corporation of this kind should be regulated by statute?

Mr. Bethell—I believe in a proper supervision of public service corporations. I believe that the true regulator is public sentiment. With publicity, as evils are disclosed, specific remedies can be applied. Effective publicity, however, under present conditions is not possible. The public is inclined to question the statements which many public service corporations publish, and justly so, because it has been so often deceived by stock jobbing and overcapitalized corporations. I believe some suitable and proper governmental machinery of supervision, to bring about a uniformity of accounting and to secure such publicity as will protect the investing and the consuming public from fraud and extortion, should be devised and set in motion. The public is entitled to this safeguard, and

it would do more in my judgment than anything else conceivable to conserve and advance the welfare of fair dealing and honestly conducted public service corporations.

This machinery should not, in my judgment, consist of the ordinary commission as usually formed and empowered, certainly not a rate-fixing commission. For often, under such a commission, the public secures the semblance of protection which is only a shield for wrongdoing, and is worse than no protection at all.

Electric Equipment of the Aberdare Collieries, England.

The Powell Duffryn Company has been operating a group of collieries situated twenty miles northwest of Cardiff, England, from which it obtains about one and one-quarter million tons of coal each year. This company has recently installed a very complete electrical system for these mines. Before the present system was put in six of the mines had isolated direct-current plants, generating at 200 to 400 volts for lighting and power purposes. In place of extending these plants for the more general use of electric power, it was decided to erect a power station to supply all of the company's pits in the Aberdare valley and thus obtain the advantage of a higher load-factor by concentrating the generating plant in one power-house. The district to be served is eight square miles in area, some points being four miles from the proposed power station. As a considerable demand for power might develop at any point in this area, it was decided to use the three-phase system, distributing power at 3,000 volts, fifty cycles. The existing direct-current systems will be retained, the steam plant being displaced by motor-generators. Electric power is now being supplied to seven of the pits from the power station. The total horse-power at present in use at the mines is about 12,170, and at present there is about 6,000 horse-power in motors installed. Records show that colliery requirements are about 1,000 kilowatt-hours for each brake-horse-power in use, with a load-factor on the power station of thirty-seven per cent. To supply this the average load on the power station would be about 1,500 kilowatts, the equipment consisting of one 1,500-kilowatt and two 750-kilowatt units. The maximum demand is at times 1,400 kilowatts, though there are momentary demands of 1,750. The transmission lines are designed to supply motors aggregating 6,000 horse-power, based on a motor efficiency of eighty-seven per cent, a power-factor of seventy-five per cent and a maximum drop of ten per cent in the line, with seventy per cent of the motors running at full load. Substations are placed at convenient distributing points, where the pressure is reduced to 500 volts for small motors and 110 volts for lighting. In some cases the substation is placed under ground close to the shaft. Each shaft has double three-core cables insulated with impregnated paper and covered with copper tape fifteen mils thick. The whole is then sheathed with lead and armored with galvanized steel wires. The motors are divided, in general, into two classes—those of variable speed for hauling and winding; those of constant speed for driving fans, pumps, screens, etc. Forty motors of the first type were in service the early part of this year, varying in output from 300 to twenty-five horse-power. Thirty-seven motors of the second type were in service, varying in output from 180 to five horse-power. The motors have in all cases been fitted to existing haulage gears, replacing the steam engines, the change-over from steam to electricity being made in one day. Since the plant has been in operation the daily load-factor is about fifty-one per cent, though the annual load-factor is less than this, due to holidays and other stops.

BOOK REVIEWS.

"Eminent Engineers." Dwight Goddard. New York. The Derry-Collard Company. Cloth. 280 pages. 6 by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.50.

This book contains short biographical sketches of sixteen Americans and sixteen Europeans who have been closely identified with mechanical progress. The biographies were originally issued as monthly numbers by Messrs. Wyman & Gordon, of Cleveland, Ohio. Some of them have, however, been rewritten. Each biography gives briefly the important phases of the life of the man dealt with and each is accompanied by a portrait. Among those whose names have been identified with electrical progress are Benjamin Franklin and Sir William Siemens. For one who does not care to go more deeply into the lives of these great men the little sketches give their noteworthy achievements.

"Single-Phase Commutator Motors." Franklin Punga. Translated from the German by R. F. Looser. New York. The MacMillan Company. Cloth. 188 pages. 5¼ by 7¾ inches. 81 illustrations. Supplied by the ELECTRICAL REVIEW at $1.75.

This book is a fairly complete treatise on the three principal types of single-phase commutator motor, the single-phase series motor, the repulsion motor and the compensated repulsion motor. The author seems to have given undue prominence to several points, as, for instance, the subject of reactance sparking, which occupies practically the first four chapters of the book and applies equally to direct-current motors. These chapters develop several interesting theories concerning the effect of brush width and brush contact resistance. And since in other respects they cover so fully the subject of direct-current commutation, it is to be regretted that they do not show the calculation of reactance voltage, taking into account the slot shape, which is a very important factor. The comparison between series-wound armatures and multiple-wound armatures is rather misleading also, but this wrong impression is corrected in one of the later chapters, as is also the seemingly undue prominence given to reactance voltage. Chapters v to x take up the commutation of single-phase motors and develop the elementary theory of all three types by the use of vector diagrams. Chapters xi to xiv give a very good discussion of the characteristics of the different types of motors and show to what conditions each is best adapted. Chapter xv gives comparative designs of the three types of motors. While these designs do not represent the best practice, they serve to illustrate the cardinal points in the design of the different types of motors.

As stated previously, the book is written in such a manner as to be rather misleading at some points, but it contains much valuable material, and, if carefully read, the conclusion will be found to be accurate.

Postal Telegraph Company to Use Octoplex Machines.

It is announced that the Rowland Telegraphic Company, Baltimore, Md., has closed negotiations with the Postal Telegraph-Cable Company to furnish the latter with an octoplex machine, one of the telegraph printing machines invented by the late Professor Henry W. Rowland, of Baltimore. The machine will be ready for delivery in about three weeks and will be the first to be operated in America. It will transmit messages between New York and Boston. Four messages are sent over one wire in each direction at the same time, each at the rate of thirty-five to forty-five words a minute. The messages are recorded in print at the sending station and are in such form as to be ready for delivery at the receiving station.

EQUITABLE RATES IN RELATION TO RATE REGULATION.[1]

BY GEO. M'LEAN.

The rule that works both ways, the ethical, the just, the sound principle, alike in commerce, in love, and in all other affairs of life, is this: "pay for what you get." It is this that gives the serene mind, the cheerful heart, the conscience void of offense to God or fellow man; and it is the quest for unearned pleasure or profit, the desire to reap where we have not sown, that produces the anxious mind, the troubled heart, the uneasy conscience.

"Pay for what you get!" It is a sentiment to which, in the abstract, we all assent. But there has been planted in every breast an instinct of justice which moves us all to resist what we may conceive to be oppression. Hence, the demand for "equitable rates" which comes alike from the public service corporation and its patrons. The one, if just, desires only a fair reward for its service, but would define such to be a profit, actual or potential, sufficient to afford an incentive to progress in efficiency and economy, a progress the benefits of which shall be shared by the patron or consumer. The latter, if a just man, is sincerely willing to pay for what he gets, but he may have false notions of cost, and one purpose of this paper is to set out what its author believes to be the facts of cost. He refers much of the distrust with which many public service corporations are regarded in their several communities to misunderstanding of their motives on the one hand and of the rights of the consumer on the other, and he believes that if this misunderstanding could be cleared away amicable and just relations between corporation and consumer would be established. The desideratum is the permanent institution of what shall be mutually recognized as equitable rates and fair treatment of all concerned.

Is there need of a campaign of education for the benefit of many consumers who intend to be just? I fancy there is. I fancy I hear many of them say, "I am willing to pay for what I get. That is my platform. But I am not willing to pay for what I don't get, and when a plundering lighting corporation sends me a minimum bill for a month's service when I have had no light, I will resent the injustice and refuse to pay."

What this indignant, but honest, consumer needs is light, perhaps not the commodity the corporation serves, but a light to the understanding. He says he received nothing and should pay nothing. He cheerfully pays the premium on his insurance policy, though he had no fire during the year, and declines to pay the minimum bill for lighting service when he has had no light, because he understands insurance and does not understand the minimum bill.

He is willing to pay for what he gets, is he? Well, then, having ordered the company to place its facilities at his disposal, he has had its service just as he had that of the fire insurance company which he did not call upon to pay a loss, but which assessed a certain portion of its expenses to his policy, a portion averaged upon the cost of carrying all its policies and risks. By the lighting corporation which sends him a minimum bill for "standing by service" or what is otherwise called "readiness to serve" charge, he is called upon to pay (usually a minor part, only,) his proportion of the following specified items of cost:

First, Investment—"Readiness to serve" cost includes a charge for interest and depreciation on the plant placed at the customers' service.

Second, Fixed Charges—This includes insurance, taxes, office rent, and such expenses for salaries and clerical labor, and other fixed expenses, as are not substantially changed as the number of consumers changes.

Third, Transformer Losses—It is important to include the cost to the company of producing the electricity used by the transformer whether light or power is, or is not, being consumed in the building connected. It may be likened to the cost of steam consumed by an engine running idle, or to the cost of gasoline consumed by the engine of an automobile churning in front of the door while awaiting the owner's coming. Applicants for service should understand that alternating current is distributed in cities generally at 2,300 volts pressure. That, to reduce this 2,300 volts pressure down to a voltage at which it may safely be admitted to buildings, a transformer is employed. That this transformer consumes a part of all the current coming to its high-pressure side during every day and every minute service wires to buildings remain in connection with it whether any current is used in the building or not. (There are some consumers who make so little use of their lamps that, for every kilowatt consumed in the lamps, twenty, or even fifty, kilowatts are used up in the transformer while waiting to serve them.)

Howsoever warmly the minimum bill or the "readiness to serve" charge may be criticised, the condemnation of it is without merit. For the principle of it runs through every line of business, and everywhere is approved. The city or town willingly, and justly, pays for fire hydrants not used during the year. The lawyer asks and gets a retaining fee for standing ready to serve. Every union printing office allows "standing time" to printers. Every union plumbing and steam fitting shop allows a man a minimum of four hours for any day on which he may report to the shop, even though he works only half an hour. The cab driver charges his customer while he waits outside ready to serve him. The landlord charges rent for his house as long as the tenant keeps it out of his possession. And so columns might be filled showing the wide application of the principle, and showing, also, its general recognition. There is the difference that, in proportion to what it costs them, the others charge much more than the lighting companies for "readiness to serve" and the further difference, generally, that the latter are corporations. But neither because of these differences, nor for any other reason that will stand analysis, can the justice of the minimum bill, nor of the "readiness to serve" charge be denied. In order that the large consumer may have an equitable rate, the lowest rate consistent with a fair return to it, the company must exact payment from the citizen who incurs a just liability for "standing by" charges.

Having now considered, and, I hope, demonstrated the justice of the lighting corporations' position on one much controverted point, the "readiness to serve" charge, made up of the investment, or interest and depreciation, cost, the fixed charges cost, and the transformer loss or, loss in transmission cost, we need only mention the fourth: operating cost, or the cost of generating, transmitting and distributing the current, which includes cost of labor, attendance and superintendence, coal, supplies, patrolling and ordinary repairs chargeable to this department.

Fifth, Reserve or Contingent Fund—This to cover fluctuations and advances in costs of labor and supplies, accidents, injuries and damages, and the obvious, or existing, risks and contingencies of the corporation's business and affairs. The foregoing factors, essential elements of any equitable rate, represent cost, and cost only.

In considering the sixth factor, profit,

[1] Paper read before the Iowa Electrical Association, Des Moines, Iowa, April 19, 1906.

we pass to the more general phases of the question of equitable rates.

The question that remains is: how are the public service corporation and the public to get what each is entitled to demand, equitable rates? How is each to be guaranteed protection against exploitation by the others? How is the one to be guarded against extortion and how is the other to be shielded against public distrust of public service corporations and of their regulation by public bodies composed of politicians, a public distrust which is the source of most municipal ownership sentiment and the shield for all malicious attacks upon public service corporations?

When shall the rates of public service corporations be regulated and by whom?

These last questions have been variously answered in various states. In some, Iowa for example, rates are subject to regulation at any time by the city council and this right to regulate at any time may not be contracted away. There are other states in which the city council may prescribe rates for the full period of the franchise or at certain intervals and still others in which the regulation is left in the hands of a state commission.

Many lighting corporations would unquestionably prefer rates not subject to alteration by public authority during the period of the contract or franchise. This would give them protection against everything except their own mistakes and competition. But no state which has enacted a statute reserving to public authority the right to regulate the rate at any time could be induced to repeal it, and if it should be repealed there would go with it the best argument against chartering a competing company, the argument that when the control of rates is vested in the public it is unnecessary to duplicate service in order to relieve the public of extortion.

Next in popularity with lighting companies apparently is the law giving public authority the right to prescribe rates at certain fixed intervals. The advantage from their point of view is that between intervals no sword of Damocles hangs over their heads. The disadvantage is the liability that the right to regulate will be exercised at the intervals prescribed in the contract. When it may be exercised at any time the liability to blackmail is constant, but the exercise of the right to regulate is rare. Moreover there is one form of intimidation, the threat of competition, to which all are exposed and to which the liability is greatest on the part of those companies whose rates can be revised by public authority at certain periods only.

The desideratum is a system of regulation which, while assuring the public a "square deal," will leave the corporation a motive for enterprise, progress and liberality, a motive for assuming risks in the effort to extend its business and increase its profits, and guarantee that others will not be permitted to reap where it has sown.

Equitable rates can be established, the progress of the municipal ownership movement retarded, if not completely arrested, and the argument against competition involving duplication of service can be made conclusive to the public mind by establishing the principle of profit sharing in the regulation of rates.

This principle might be put into effect by establishing fair standard prices and making reductions from these prices dependent upon output or dividends.

England has a sliding scale, dependent upon earnings and under which the so-called standard rate may be lowered or advanced. In our country a standard rate meeting the requirements of public sentiment would be a maximum rate. In some cities under contract sliding scales have been established under which rates decline from year to year, or from period to period, until a certain minimum is reached. This plan, while possessing certain advantages, is imperfect, since when the minimum rate is reached the liability to competition, especially from the municipality itself, is revived. On the other hand, when the rate is made dependent upon actual, and not estimated, total consumption, or upon dividends, the regulation, as closely as possible, becomes automatic.

Nothing in this world is perfect and the dividend test is no exception, but, assuming fair basic terms, it is the one which, while absolutely satisfactory to the company seeking only a fair return on its investment and a fair reward for its enterprise, seems most likely to satisfy the public that it is getting a square deal and would be guilty of folly were it to authorize duplication of the service by the municipality or private enterprise.

Let us say that a maximum charge having been prescribed, the standard rate of dividend is fixed at seven per cent on the actual value of the property, as tested by cost of reproducing plant and cost of reproducing its business, or according to the test the United States Supreme Court has laid down in the case of Smyth *vs.* Ames, [169 U. S., 466]. Then let it be provided that for every increase of one per cent, or one-half of one per cent, above the standard dividend a certain reduction in price shall be made to consumers. This would mean actual profit sharing. The enterprise would become a mutual concern and the public would be assured full participation in the profits resulting from the economies practiced under capable management of a lighting property. Municipal ownership now has its advocates among those who admit that municipal waste equals corporate profit. They say they would rather the profit were wasted in the employment of needless labor, or in liberal compensation to municipal employés than reserved to capital, since the public pays the freight in either case. The argument is fallacious because the public interest lies in rates and service and municipal ownership therefore can be justified only by showing that it means improvement in rates or service, or both, but it is an argument the public service corporation could meet most effectively by taking the public into partnership in the manner already described.

In conclusion it may be said that a prolific source of prejudice against public service corporations is the glittering prospectus of the promoter, in which the profits of the lighting company whose securities are for sale are set forth in most alluring fashion. In these proclamations the prosperity of the concern is often exaggerated by representing its revenue over operating expenses, taxes, and ordinary repairs as profit, when the fact is that, assuming all disbursements for items properly belonging to operating expenses are charged as such, and not to investment, the balance shows not profit alone, but profit plus depreciation, plus value of the insurance and the indemnity against all contingencies and hazards of the business, which cost or value has not been charged to operating expenses, as it properly might have been, the company having borne the risk.

Of course, proper deductions should be made for depreciation, reserve or contingent fund, and various forms of insurance, even though the company carries its own insurance, against many or all contingencies. When this prospectus or statement mentioned falls into the hands of a newspaper making a campaign for lower rates, a new company, or a municipal plant, it is accepted as proof that the profits resulting from a certain volume of business at a certain rate are inordinate and that lighting companies generally are practicing extortion upon the people. As a fraternity we should frown upon these exaggerated statements and by fair dealing with the public endeavor to establish relations of comity between the public service corporations and the people.

Electrical Notes from Europe.

(By Our Special Correspondent.)

SOME useful data as to the use of electric locomotives for hauling freight trains and the cost of operating have recently been obtained from the reports concerning the operation of an electric railroad which runs from Heidelberg to Wiesloch, over a distance of eight miles. The hauling is carried out at the rate of eight miles an hour, on the average. The contract stipulates that an annual amount of freight equal to 50,000 tons is to be taken from the quarries to the cement factory, which lies about three miles off, and this is to cost $0.14 per ton for the transportation, making $0.046 per ton-mile. The electric locomotives which are used in this case are equipped with two motors of thirty kilowatts each. The track is a thirty-nine-inch gauge. By the use of improved controllers the locomotives are given seven different speeds, and the motors are operated from a cabin in the middle of the locomotive. Current is brought from an overhead wire by two bow-shaped trolleys. As regards the freight cars, they weigh 6.6 tons when empty, and are designed to carry a load of 4.8 tons. The train is usually made up of one of the above-mentioned locomotives and three cars, making a total weight of 14.3 tons, while the load figures thirty-one tons for the whole train. The weight of the empty train in proportion to the freight load carried is forty-six per cent and to the total weight thirty-two per cent. In an ordinary railroad this is about sixty-three and thirty-eight per cent, respectively. When making the up grade the train takes about six kilowatt-hours, or 0.88 kilowatt-hour per locomotive-mile, and on the down grade this is ten or fifteen per cent less. In the year 1904 the road ran 36,000 train-miles, taking 25,312 kilowatt-hours. The trains are loaded in the present case in about seven minutes, and the distance of eight miles is covered in one hour.

The recent experiments which have been made by the two French savants, Messrs. Couriot and Menier, upon the action of incandescent wires or filaments upon fire-damp showed some interesting results. It appears that the conductor alone has no effect upon bringing about an explosion unless it becomes broken and an arc is formed. Different metals were used to form filaments and these were brought to a high temperature, but a mixture of fire-damp and air could not be thus exploded as long as the filament is unbroken. A lamp bulb filled with fire-damp did not explode even at a very high voltage, but when the filament broke and caused a spark an explosion followed. These experiments show the difference between fire-damp and illuminating gas in this respect. The difference is thought to be due to the different ionizing properties of the gases in question. It has been already shown that chemically prepared gases only contain ions having a large volume and a small mobility. It is not necessary that the wire should be incandescent at the time of breaking in order to cause an explosion, as a series of trials with wires made of lead and other metals was made. The explosion can be avoided by using a shunt circuit around the break point, but the resistance should not be too high in this case to secure a good effect. Self-induction in the shunt circuit is likely to cut down the chance of an explosion, and it is therefore to be recommended.

The French government recently decided to transfer the postal, telegraphic and telephone department, which was formerly under the minister of commerce and industry, to the minister of public works, to which it more properly belongs, and this will avoid the numerous complications which arose under the old system. The decree making this change went into effect on March 14 last. It is expected that a greater economy will also be obtained under the new system.

Among the new electric plants which have been erected in Roumania may be mentioned the new station for lighting and power in the town of Ploescu. The total capacity of the plant is somewhat under 400 horse-power. The boiler room contains two Babcock & Wilcox boilers, each having 270 square yards heating surface, capable of vaporizing 8,000 pounds of water per hour. The grates are laid out so as to use either coal or naphtha as fuel, and for the latter they have been equipped with spray jets. At present the plant contains a 300-horse-power tandem compound engine, built by Van den Kerchove, of Ghent. It is direct-coupled to a 200-kilowatt generator of the Pieper multipolar pattern, running at 125 revolutions per minute. The generator will deliver about 1,500 amperes at 500 volts. At the present time the streets are lighted by arc lamps, and there are a considerable number of subscribers for incandescent lamps and motors.

An electrochemical company of Frankfort has recently brought out a process for the destruction of phylloxera by the use of current, and it is claimed that the electric method is very efficient and acts without injuring the vines. The company proposed to the Bavarian government to have the new system officially tested, and after considering the matter the authorities decided to make a series of tests. The latter are to be carried out at Wurzburg, and the ground for the purpose is already selected. It is desired mainly to see whether the application of the current will do any harm to the vines. Should the results of the tests be favorable, it is proposed to use the system on a larger scale in a district where the phylloxera prevails.

In order to carry out wireless telegraphy between moving trains to a better advantage it is necessary to find some method of mounting the mast upon the trains, but hitherto this has not been done in practice owing to the difficulties from the wires which cross the track, and also from the bridges and tunnels. A German engineer, M. Kittsee, has found a method of applying a sufficiently high mast to a train. To carry this out he mounts the mast upon the roof of the car and uses a base which is built on about the same principle as the base of a trolley pole of an electric car. The mast can thus be lowered out of the way when it meets an obstruction. To make the system practical some means had to be found for lowering the mast automatically and at the proper moment before coming to the obstacle. This is done by a magnet-operated device which lowers the pole. A contact is placed upon the track at the proper distance from the obstacle and it makes the current through the magnet at the proper time. This arrangement is a very simple one and is said to be very successful in practice.

A new form of dry battery, known as the "Dura" cell, has been brought out by a Berlin firm. It is claimed to be superior to the usual form of gelatine dry battery, seeing that the electrolytic action is constantly kept up, and, although this may be very slight, in the course of a long time it amounts to something, and this lowers the capacity of the battery. In the new "Dura" cell the salts are claimed to remain quite dry for an indefinite length of time. When the battery is to be used water is poured in through a filling orifice, when the electrolyte soon dissolves, and owing to its composition with suitable substances it forms a semi-solid and gelatinous mass like that of the usual dry battery. With-

in a short time after filling the cell is ready to give its full current. An improvement over the usual method of putting on the cover is also found. Instead of sealing it on by a fusible substance, which has some disadvantages, a new form of cork cover is used. The internal resistance of the cell is low and it gives a comparatively high current. It also depolarizes very quickly.

A new electrolytic process is now in use in Germany for producing tetrachloride of carbon, and this is now being applied on a large scale in a factory of some size. Briefly described, the new process consists essentially in using a strong electric arc to heat a mixture of coke, salt and sand, in which all the materials are carefully dried before putting in the furnace. No air is allowed to enter the furnace during the heat. By the action of silica on the chloride of sodium, chlorine gas is produced under the heat of the arc, with formation of silicate of soda. At the same time silicon is produced by the reduction of the silica. The chlorine gas which is set free by this reaction combines with the carbon to form tetrachloride of carbon in the gaseous form. The latter is led off from the furnace through piping and is received in a set of condensers, where it is cooled to the liquid form. The furnace may be made to yield tetrachloride of silicon by somewhat modifying the conditions of operating. The latter body acts upon the phosphate of calcium and will produce pentrachloride of phosphorus, whence phosphoric acid can be obtained.

It is reported that the railway administration of the Italian government has recently placed an order with Ganz & Company, of Budapest, for two new electric locomotives, which are to have about the same general appearance as the locomotives furnished in 1904, and one of these is to be finished in time for the opening of the Milan Exposition of this year. These locomotives are of the three-phase type, and while the truck and the body are about the same as before, the electrical outfit has been redesigned and considerably changed from the preceding type. Five axles are used on the truck. Three of these are coupled together, and upon the other two are mounted the motors, this arrangement being about the same as before, and a load of fourteen tons rests upon each of the former axles and ten tons on each of the latter. As regards the electrical equipment of the new locomotives, there are two three-phase motors working at 3,000 volts. The motors run on thirty cycles. The first motor has eight poles and the second twelve poles. The driving wheels of the locomotive are five feet in diameter and the train has an average speed of forty miles an hour. Each of the motors will furnish about 1,500 horse-power. The above speed is obtained by using the eight-pole motor alone, while the train can be run slower, at twenty-five miles an hour, by changing over to the twelve-pole motor. A still slower speed of fifteen miles an hour is secured by running the two motors in series.

Electrical enterprises are on the increase in Bulgaria, and among the new electric plants which have been recently erected is noted the hydraulic plant on the Iskar river. From this stream it is now possible to secure some 1,500 kilowatts with the present hydraulic construction. Leading from the dam across the stream is a canal which runs for 3,700 feet and ends in a settling chamber. A penstock starts from the latter and leads down to the turbine station. The penstock is about five feet in diameter and the head of water which is obtained in this case is about 180 feet. The new plant has been erected in order to supply current to the town of Sofia. It lies about fourteen miles from this locality. In the turbine station are placed Piccard & Pictet (Swiss) turbines, which operate at 400 revolutions per minute and have a capacity somewhat under 400 kilowatts. The wheels are direct-coupled to three-phase alternators of the Oerlikon type. These machines deliver 8,000 volts at fifty-three cycles when running at 400 revolutions. Each alternator has fixed to it a ten-kilowatt, fifty-volt exciter. Aluminum bars mounted on porcelain insulators take the current to the switchboard. From the station runs an overhead line, which is mounted on wood poles and supplies a number of transformer posts. The main transformer post within the town has a capacity of 400 kilowatts, and lowers the main voltage from 7,500 to 160 for the lighting circuits. Other transformer posts of 250 kilowatts capacity are also used on the lines. It is expected to increase the capacity of the station in the near future.

Among the new Swiss electric roads is the line which runs from Lausanne to Moudon, having a total length of fifteen miles, besides a short branch line between Savigny and Tumerin. Electric cars, either singly or with trailers, are used in this case. The overhead trolley wire is operated at 750 volts, direct current. An electric plant which has been lately built at Montbovon furnishes the current for the line. This plant is run on the three-phase system and supplies current at 8,000 volts. Near the road are a number of substations which lower the voltage to 750 and are equipped with rotary groups working at 500 revolutions per minute.

Another new electric road in Switzerland is the La Gruyere traction line, which connects a number of localities and runs between Palezieux and Montbovon. The total distance is twenty-five miles. In this case the region has many sharp grades and turns, so that considerable care had to be taken in laying out the road. Two kinds of motor cars are used here. The first is a four-axle car, with a thirty-five-horse-power motor mounted on each of the axles. In the second car are four eighty-horse-power motors, and these are able to haul a 140-ton load up a heavy grade at a speed of ten miles an hour. The electric station of Montbovon supplies current for this line as well as for the preceding one. Four substations are placed at intervals along the road. Each of these contains three converting groups, consisting of a three-phase non-synchronous motor of 100 horse-power, coupled direct to an Alioth (Swiss) generator. Three groups operate at 580 revolutions per minute. The three-phase motors work at 500 volts, while the generators are designed to deliver from 750 to 1,000 volts.

C. L. DURAND.

Paris, May 1.

Electric Lights for Mount Burgenstock.

The station on the Burgenstock Mountain Railway, at the end of the line, is about 510 feet below the summit. An electric lift has recently been erected, and set to work with a vertical travel of 495 feet. The lower part of the metallic guides are anchored in a shaft excavated through the rock. The upper braced lattice work, representing 385 feet of the total length, is attached to the almost perpendicular mountain by supports at different points. A bridge thirty-seven and one-half feet long connects the top of the lift-race with the mountain, across which is the exit for the passengers. The cage is supported by three cables, each of 0.525 inches diameter. One of these carry a counterweight, the other two are carried over a drum of six and one-half feet in diameter. Each of these cables can support a weight of sixteen tons. The exit at the bottom of the shaft is by a horizontal tunnel cut through the rock to the station platform. The time taken for the ascent is three minutes, the motive power being supplied by a twenty-five horse-power motor working at a speed of 900 revolutions per minute on a 1,200-volt circuit. When, however, a train is approaching a station the voltage drops as low as 900, with a consequent reduction in the speed of the lift motor. Automatic stopping and safety devices are employed to comply with the requirements of the official regulations.—*Electrical Engineer (London)*.

Report of the International Waterways Commission.

The International Waterways Commission has made the following report to the Secretary of War, Washington, D. C., by the American members and to the Canadian Minister of Public Works by the members of the commission from Canada, concerning the investigation of conditions at Niagara Falls:

The commission has made a thorough investigation of the conditions existing at Niagara Falls and the two sections have presented reports to their respective governments, setting forth these conditions to which attention is invited. The following views and recommendations are based upon a careful study of the facts and conditions set forth in these reports:

1. In the opinion of the commission, it would be a sacrilege to destroy the scenic effect of Niagara Falls.

2. While the commission are not fully agreed as to the effect of diversions of water from Niagara Falls, all are of the opinion that more than 36,000 cubic feet per second on the Canadian side of the Niagara river or on the Niagara peninsula, and 18,500 cubic feet per second on the American side of the Niagara river, including diversions for power purposes on the Erie canal, can not be diverted without injury to Niagara Falls as a whole.

3. The commission therefore recommend that such diversions, exclusive of water required for domestic use or the service of locks in navigation canals, be limited on the Canadian side to 36,000 cubic feet per second, and on the United States side to 18,500 cubic feet per second, and in addition thereto a diversion for sanitary purposes not to exceed 10,000 cubic feet per second be authorized for the Chicago drainage canal, and that a treaty or legislation be had limiting these diversions to the quantities mentioned.

The effect of the diversion of water by the Chicago drainage canal upon the general navigation interests of the Great Lakes system will be considered in a separate report.

The Canadian section, while assenting to the above conclusions, did so upon the understanding that in connection therewith should be expressed their view that any treaty or arrangement as to the preservation of Niagara Falls should be limited to the term of twenty-five years and should also establish the principles applicable to all diversions or uses of waters adjacent to the international boundary and of all streams which flow across the boundary. The following principles are suggested:

1. In all navigable waters the use for navigation purposes is of primary and paramount right. The Great Lakes system on the boundary between the United States and Canada and finding its outlet by the St. Lawrence to the sea should be maintained in its integrity.

2. Permanent or complete diversions of navigable waters or their tributary streams should only be permitted for domestic purposes and for the use of locks in navigation canals.

3. Diversions can be permitted of a temporary character, where the water is taken and returned again when such diversions do not interfere in any way with the interests of navigation. In such cases each country is to have a right to diversion in equal quantities.

4. No obstruction or diversion shall be permitted in or upon any navigable water crossing the boundary or in or from streams tributary thereto which would injuriously affect navigation in either country.

5. Each country shall have the right of diversion for irrigation or extraordinary purposes in equal quantities of the waters of non-navigable streams crossing the international boundary.

6. A permanent joint commission can deal much more satisfactorily with the settlement of all disputes arising as to the application of these principles, and should be appointed. The American members are of opinion that the enunciation of principles to govern the making of a general treaty is not within the scope of their functions; moreover, the jurisdiction of the American members is restricted to the Great Lakes system.

Coal Improved by Storage in the Sea.

Important experiments have been carried on by the naval authorities at Portsmouth, England, for some time, to ascertain the extent of the steaming properties of fresh coal, which has been improved by storage in the sea. Eighteen months ago iron crates, each containing two tons of coal, were sunk in a big basin in the dock yard. At the same time a similar quantity of coal was carefully stored in the open air at a coaling point and sheltered by tarpaulins.

At intervals of six months, two-ton samples of exact storage have been taken and carefully burned. The results have shown conclusively, that by the submarine storage of coal its calorific value steadily increases, while by storage in the open air a decided decrease is shown. At naval stations in the tropics the decrease in calorific value is very great, the heat of the sun extracting the light, volatile oils.

The admiralty is satisfied with the physical and financial advantages of submarine storage, and has now directed that experiments be made to ascertain its practicability on a large scale. The difficulty is that submerged coal must be dried before it is used or otherwise the superficial moisture would soon cause spontaneous combustion. Close confinement in the bunkers of warships is the only method of drying heretofore attempted. Spreading quantities of thousands of tons in the open air has not been feasible.—*American Manufacturer.*

The Opening of the Hotel Belmont.

The new Hotel Belmont, at Forty-second street and Park avenue, New York city, was opened for the inspection of 6,000 or more invited guests on Monday, May 7. The hotel consists of twenty-eight stories, and is 368 feet in height. Five stories are below the street level. Four years have been consumed in erecting the building, which, with its equipment, cost about $7,000,000. Seven thousand tons of steel have been used in the construction.

Beginning at the foundation, sixty-eight feet below the surface, the two lower basement floors are given up to the mechanical equipment. This includes a boiler plant of 1,700-horse-power capacity, an electrical generating apparatus of 1,200-horse-power capacity, and exhaust steam-heating system, ventilating system, a seventy-five-ton ice plant, filtering apparatus for water and air, fire service pumps, garbage incinerator, vacuum cleaning system, coal storage for 800 tons, and elevator machines.

There are sixteen electric elevators and ten electric dumbwaiters, and pneumatic tubes running from the lowest basement floor to the roof. The pneumatic tubes have discharge pockets on each floor for the despatch of messages, cards and mail.

The third basement contains the main laundry and mangle rooms, wine cellars, surgeon's office, printing office and storage for baggage.

The guest rooms are equipped with outside windows, artificial ventilation, telephones, electric clocks and electric hair-curlers. The temperature is regulated throughout the entire building.

The lighting arrangements are on a most elaborate scale, the use of crystal in the electroliers making the effect one of remarkable beauty.

The location of the Hotel Belmont makes possible a passage leading directly from the hotel to the subway, which at this point turns the corner from Park avenue to Forty-second street. This passage also extends to the Grand Central terminal of the New York Central & Hudson River Railroad, which is directly opposite the hotel.

On Monday evening an elaborate banquet was served, presided over by Mr. Frank Presbrey, who was toastmaster. Among those who made brief responses were August Belmont, George H. Daniels, Martin W. Littleton, Louis Wiley and E. Wildman. Among others present were: Otto M. Eidlitz, J. B. Walker, Charles W. Price, A. Spies, H. H. Supplee, G. B.

Creveling, J. F. Tremain, Louis Cassier and B. L. M. Bates, manager of the hotel. A gold-mounted souvenir paper-weight in the form of a miniature model of the hotel was presented to each guest in a leather case, the guest's name being inscribed on the holder.

Corner-Stone of United Engineering Building Laid.

The corner-stone of the United Engineering Building was laid on Tuesday, May 8, at 5 P. M., by Mrs. Andrew Carnegie. The exercises were brief and informal, the members of the conference committee and a few others directly interested being present.

The corner-stone is a block of carved granite that was put in place over a metal box containing several souvenirs, including the local newspapers of May 8, the Bible, and all the coins of the United States now in circulation. The box also included a gold plate, upon which was engraved:

"To the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers and the Engineers' Club: It will give me great pleasure to devote, say, one and one-half millions of dollars to erect a union building for you all in New York city. With best wishes.

"Yours very truly,

"ANDREW CARNEGIE.

"March 11, 1904."

Mrs. Carnegie was presented with a silver trowel and an ivory gavel. She was accompanied by her daughter, Margaret.

The introductory speech was made by E. E. Olcott, president of the United Engineers' Society, who said, in part:

The day of small things is past. If we are to keep pace with the wonderful march of progress we must bore with a large auger. We need more than ever the conservation and uniting of all our forces for the accomplishment of great ends. It is the scientifically educated engineer who must direct the immense establishments which from now on must be the rule. He is necessary to prevent the waste both of capital and material. Our national resources must be husbanded, not prodigally despoiled; our coal, iron and timber must be handled in the most intelligent way. It will be largely with the members of this society, now united in this great building, to direct our great body of workers.

The successful engineer must also be a humane engineer. He must think for the men who make possible the accomplishment of his plans. Such scientific bodies as are here represented do much to place within reach of the masses the results of all discoveries. When we receive 45,000 immigrants a week we are forced to ask ourselves what the country will come to unless these men are intelligently and judiciously directed. A president of the Society of Mining Engineers, Abram S. Hewitt, urged the anthracite operators to set aside five cents for every ton of coal produced for improving the condition of the miners. High-minded leadership is the only salvation of our civilization. This has been manifested by Mr. Carnegie, our benefactor. Through his generosity we may preserve and put in tangible form records of scientific accomplishments so as to avoid a repetition of mistakes of the past.

Mr. Carnegie was called upon for some remarks and said briefly that he congratulated the engineers on the near completion of these magnificent quarters. He was glad that it was a union home where the various branches of engineers could gather and discuss matters of interest. In Europe the engineering societies—mechanical, electrical and mining—were far apart. The Americans believed in mixing things. If the Europeans were to compete they would have to get closer together. The principle of union in science was correct. It was just as important as union in politics. Mr. Carnegie referred to the oldest engineer present, Charles Haynes Haswell, as the first chief engineer and first engineer-in-chief of the United States navy. Mr. Carnegie declared that the world would be a very poor sort of place without engineers. He hoped that the building would soon be completed, and that he would meet with all present at the first banquet.

Among those at the ceremonies were George E. Weed, Charles Wallace Hunt, R. A. Franks, Theodore Dwight, Bion J. Arnold, Charles F. Scott, James M. Dodge, Dr. S. S. Wheeler, John Fritz, W. H. Fletcher, R. W. Raymond, T. C. Martin, Ralph W. Pope, Professor F. R. Hutton, Dr. R. A. Ledoux, John Thomson, W. A. Redding and Calvin W. Rice.

Submarine Cables.

A paper on "Submarine Cables" was read by Mr. W. Smith at a meeting of the Birmingham (England) and District Electric Club recently, a brief abstract of which is given in the *Electrician*, London. For electric light and power conductors under the sea, the author recommended vulcanized rubber insulation. Telegraph cables, he explained, on the other hand, are almost universally insulated with gutta-percha, and cables made at the present time differ but little from those made in the early days of ocean telegraphy. The conductor, insulated with gutta-percha, is taped, then protected by some fibrous material, sheathed with galvanized iron or steel wires and finally finished off with a serving of yarn and tape. The author mentioned the various grades of armoring, the deep-sea, intermediate and shore-end, with over-all diameters of about one inch upward. As a protection from the ravages of certain small marine animals, he said, powdered silica is often mixed with the compound applied when serving the cables, and as a further protection a wrapping of brass tape is sometimes applied. He next mentioned the "All-British Pacific" cable, opened to the public in December, 1902, of which the section between Fanning Island and Vancouver is the greatest length yet laid in one piece—about 4,000 geographical miles. This particular portion of the cable is made in a rather different manner to the remainder; the conductor consists of five strands, the four outers being closed round the central wire in such a manner that while retaining the advantages of a strand, there is almost as much copper as in a solid conductor of equal diameter. Thus, without much loss in conductance, the capacity is considerably reduced. Various forms of light, that is, of low specific gravity, cables had been employed, he continued, but apparently with little success. In order to keep down the weight it had been suggested to protect submarine cables with a layer of aluminum tape, but it was doubtful whether this would be satisfactory, considering the rapid action of chlorine on aluminum. He next referred briefly to "loading" telephone cables with inductance. It did not appear feasible to use an alloy for the conductor, he said, as alloys had a higher resistance than their constituents when taken separately. If inductance coils were introduced, iron must be very carefully employed or sounds were not clearly transmitted. Any such apparatus, although comparatively easy to attach to underground lines, would, he thought, be difficult to use in the case of a submarine cable lying in a depth of some 3,000 fathoms. Air spacing (which he stated incidentally did not appear to have been a success on some underground lines) could hardly be suggested for deep-sea cables. As well as transmitting the sound, some means were required to rectify the tendency of the sound wave to distortion; not only was it necessary to have amplitude, clear articulation was also required.

A LOW-RESISTANCE THERMOELECTRIC PYROMETER AND COMPENSATOR.[1]

BY WILLIAM H. BRISTOL.

This thermoelectric pyrometer is similar in principle to the Le Chatelier pyrometer, but is of low resistance, and instead of the extremely delicate suspension galvanometer, a Weston special dead-beat milli-voltmeter is used; and in place of the costly platinum-rhodium elements, inexpensive alloys are employed for the couples.

For ranges of temperature up to 2,000 degrees Fahrenheit, instead of using porcelain tubes for insulation, each element of the couple is insulated with asbestos and a carborundum paint.

For a great variety of industrial processes, and also in scientific research, the ranges of temperature required do not exceed 2,000 degrees Fahrenheit. This pyrometer has been developed to meet the existing demand for an instrument to fully cover this range of temperature. The pyrometer depends primarily upon the well-known thermoelectric couple consisting of two dissimilar metals or alloys joined at one end. The pyrometer consists of three parts—an indicator, couple and leads to connect the couple and indicator. The leads between the couple and the indicator may be of almost any desired length to meet the special requirements, the combined resistance of the leads, couples and indicator being fixed to suit the total range of the instrument, and varying from three ohms, as a minimum, to ten ohms, as a maximum. The indicator is a low-resistance instrument of special design, and is made especially for the writer by the Weston Electrical Instrument Company.

Fig. 1 shows a wall or switchboard form of the indicator. Fig. 2 illustrates a portable form. These indicators are made with pivots in jewel bearings, in place of the delicate suspension by fine wires, which are generally considered necessary in the high-resistance type of indicator or galvanometer for this work.

The elements used in the low-resistance system give a much greater electromotive force than the platinum-rhodium couple, which is a great advantage in gain of motive power for the operation of the indicating instrument.

As the result of many experiments with different metals and alloys to determine suitable materials to meet these requirements, couples have been finally adopted which consist of alloys of tungsten, steel, nickel, iron and copper, different alloys being employed to suit the total ranges of temperature that it is desired to have the scale cover.

Since no rare metals are used for the couples, this part of the pyrometer is inexpensive, and it is possible to employ elements of large cross-section, which will not be affected in their resistance any appreciable amount by the variation of temperature along the lengths of the elements forming the couple.

The leads to the indicator are made of flexible insulated copper duplex cable of ample cross-section to practically eliminate the influence of variations of atmospheric temperature.

A novel feature of the couple is that it is made separable at the point where it passes through the wall of the space within which the temperature is to be measured. The object of the joint is twofold—first, to make it possible to renew the "fire end" whenever it may be necessary, and, second, to permit carrying the cold ends of the elements to a point toward the floor where the atmospheric temperature will be constant, and not influenced by the temperature that is being measured. Fig. 3 shows a complete element with separable joint, coiled leads and lamp plug on the end of the couple forming the leads for convenient connection to the indicating instrument. The details of the joint are clearly shown in Fig. 4.

The elements of the couple are independently insulated in a novel and effective manner by winding each with asbestos cord and then coating the surface with carborundum paint, a solution of silicate of soda being used as a binder.

For continuous applications of the couples to temperatures in the neighborhood of 2,000 degrees Fahrenheit or over, special protecting tubes of nickel, plumbago or porcelain are employed. The pyrometers are furnished with scales for total ranges of 600, 1,200, 2,000 and 2,600 degrees Fahrenheit. These scales are clearly shown in Figs. 1 and 2. The graduations of these scales are determined by the fusing temperatures of lead, zinc, aluminum and copper, which give sufficient points on the curves for use in making a complete graduation of the scales. The divisions are further checked by the use of a standard Le Chatelier platinum-

FIG. 1.—SWITCHBOARD FORM, ELECTRIC PYROMETER.

FIG. 2.—PORTABLE FORM, ELECTRIC PYROMETER.

[1] Abstract of a paper presented at the meeting of the American Society of Mechanical Engineers, Chattanooga, Tenn., May 1-4, 1906.

rhodium couple and a Siemens & Halske suspension galvanometer.

A novel application of the thermoelectric couple is that of determining the temperature of molten metals. It consists in leaving the ends of the elements disconnected and without insulation. When these ends are slightly immersed in the molten metal it makes a junction between the elements, and the reading will be the same as if the elements of the couple had been originally joined. The advantage of this plan is that the reduced cross-section at the ends of the couple allows it to almost instantaneously attain the temperature of the molten metal; consequently, there is no lag error.

For refined measurements it is necessary to make allowance for changes of temperature at the cold ends of the couple when readings are taken, unless some means is provided to maintain them at a constant temperature.

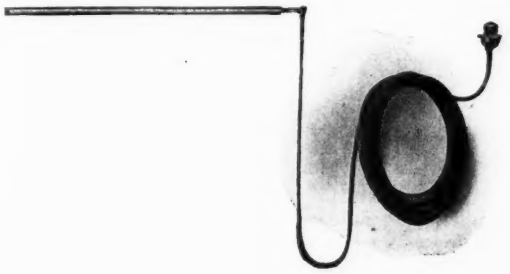


FIG. 3.—COMPLETE ELEMENT, WITH SEPARABLE JOINT.

FIG. 4.—DETAILS OF JOINT.

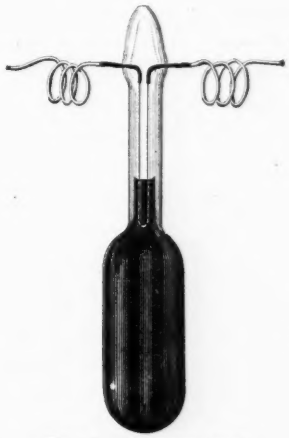


FIG. 5.—COMPENSATOR.

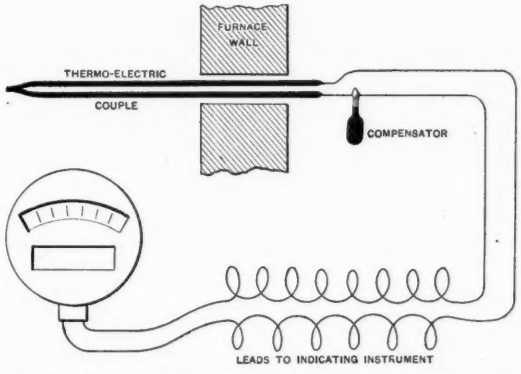


FIG. 6.—DIAGRAM SHOWING COMPENSATOR CONNECTED IN CIRCUIT.

A compensating device to automatically correct for changes of atmospheric temperature at the cold ends has been devised. This compensating device is shown in Fig. 5. It consists of a glass bulb with a short stem, similar to an ordinary mercurial thermometer. Two platinum terminal wires are fused into the stem near its top. These are connected within the bore of the stem by a loop of fine platinum wire, thus completing the circuit, as indicated in diagram (Fig. 6). The size of the bulb, the cross-section of the stem and the cross-section of the platinum wire loop are proportioned to suit the case in hand.

The compensator will regulate for any particular point on the scale, as, for instance, the working point, where it may be desired that the reading shall be absolutely independent of changes of temperature at the cold ends. It will readily be seen that if the temperature rises at the cold end, the mercury rising in the stem will short-circuit a certain portion of the platinum loop, thus reducing the resistance of the entire circuit by exactly the necessary amount, so that the diminished electromotive force of the couple due to the rise of temperature of the cold end will send the same amount of current through the circuit and instrument, and consequently give the same reading as if there had been no change of temperature at the cold ends. The compensator acts on precisely the same principle, but in the reverse manner. When the temperature falls at the cold ends the resistance of the circuit is increased as the column of mercury lowers in the stem. The increase produced in the resistance of the circuit prevents the increase of the electromotive force of the couple due to the fall of the temperature at the cold ends from sending an increased current through the instrument; therefore the reading remains unchanged.

Many applications of this instrument will suggest themselves. A few of the important ones are mentioned, as, for example: in a boiler test where nineteen couples were simultaneously applied at different points between the furnace and the flue. From the data obtained a curve was drawn showing the temperatures at all points along the path of the products of combustion from the furnace to the flue, the abscissas corresponding to the square feet of heating surface, and the ordinates to degrees Fahrenheit. The value of such data for investigating and studying the economical working of steam power plants will be appreciated. The couple can readily be applied to the steam space of a boiler and used to show the degree of superheating.

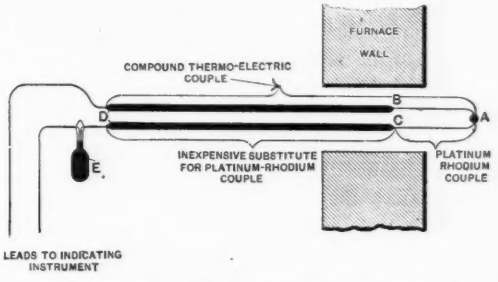


FIG. 7.—MODIFYING LOW-RESISTANCE PYROMETER FOR HIGHER TEMPERATURES.

These instruments have also been adapted to and are especially valuable in maintaining the desired temperatures for annealing, hardening, tempering and blueing of steel.

When many small parts are handled, as in the manufacture of watches, a practical method of using the pyrometer is to adapt the pot containing the articles to the end of the couple and using it as a handle for

inserting the pot into the furnace or into an ordinary forge fire. By revolving the pot it is heated perfectly uniformly, and as soon as the proper temperature is reached it is known on the indicator, and all guesswork is eliminated.

They have been most successfully employed in lead-hardening baths. For this purpose the couples are protected by wrought-iron pipes, and will last for months without renewal. After constant daily use for many weeks the couples give the same readings as when first installed.

For the rapid measurement of the temperatures of objects and metallic bodies the thermoelectric couple may be employed to great advantage. For illustration, if it is desired to obtain almost instantaneous indications of the temperature of a metallic plate, the ends of the elements forming the hot end of the couple may be left disconnected and reduced to points at their extremities. If the pointed ends of such a couple are pressed against the surface of the plate at the desired point, the metal will serve as the electric conductor between the end points of the elements, and their junctions will immediately assume the temperature of the plate, giving a corresponding instantaneous response on the indicating instrument.

By simply pressing the points of the couple at different places on the metallic body the different temperature at the various points may quickly and accurately be determined.

For application of this form of the couple to the measurement of the temperature of objects that are not electric conductors, a thin metallic sheet may be placed on the surface of the object and the couple then pressed against it.

To ensure that the temperature of the junction is that of the object itself, a sheet or layer of heat-resisting material, as asbestos, may be applied to the object at the point when the temperature is desired.

The elements of the couple may be joined in the usual manner and then pressed against the object. When so made this method of measuring the temperature of solid objects is equally applicable, whether the objects are electric conductors or not.

To make the low-resistance thermoelectric pyrometer applicable for measurement of temperatures as high as 3,000 degrees Fahrenheit where the couple is to be exposed to the full heat to be measured, metals like those of the Le Chatelier couples or their equivalents having high fusing points must be employed. A compound couple, which will serve the same purpose as that of platinum-rhodium, has been devised, but which is less expensive.

It consists of two parts, which, together, form the complete couple, as indicated in Fig. 7. The part which is exposed to the full heat to be measured is made of platinum-rhodium and is of sufficient length to reach a point where the temperature will not exceed 1,200 degrees Fahrenheit. From this point to the extreme cold ends of the couple the elements are made of inexpensive alloys, as indicated in Fig. 7. This portion of the couple is of ample cross-section to eliminate changes of resistance that would otherwise be produced by variations of temperature along the length of the couple.

Two thermoelectric junctions, B and C, are introduced into the circuit where connection is made between the low-priced alloys and the platinum-rhodium elements, but the electromotive forces generated at these points may be made equal and opposed to each other if the proper alloys are employed.

Although no common metals or alloys have as yet been found which give a perfect balance or neutralization of the thermoelectric effects for wide variations of temperature at the secondary junctions B and C, it has been determined that alloys of iron and nickel will give a very close balance for ranges of temperature from the atmosphere to 1,200 degrees Fahrenheit at these points. For this range of increase of temperature at the secondary junctions there is a small positive excess of electromotive force which may be compensated for by the introduction of an auxiliary resistance into the circuit in close proximity to the secondary junction, the resistance being placed in series and made of material which will increase in resistance with the rise of temperature at the junction, and consequently the compound couple taken as a whole will be the same as if the entire couple was made of the platinum-rhodium elements.

Automatic continuous records of the indications of this pyrometer may readily be made on a chart sheet which is arranged to move at the proper rate just behind the end of the indicating arm, but not in the least interfering with its natural motion. The record sheet is unsupported over its active portion and is periodically vibrated by the clock movement into contact with the end of the indicating arm and produces a record upon the chart sheet showing its position at the instant of vibrations. By timing the period between the vibrations of the chart the contacts may be made so as to produce a continuous record.

The record may be made by ink carried by the indicating arm or the surface of the record sheet may be coated with some easily removable substance.

For recording automatically rapid changes of temperature, a current from an induction coil may be passed from the end of the indicating arm through the chart at frequent intervals.

National Electric Light Association.

In connection with the meeting of the National Electric Light Association at Atlantic City, June 4-9, Arthur Williams, chairman of the convention committee, has issued a special circular as to hotel accommodations. It gives a list of forty-nine hotels, all guaranteed by the Hotel Men's Association to give good service at the rate scheduled. For each hotel, except three, the fullest details are given as to rooms, and as they are all on the American plan, the delegate and his friends can estimate closely the outlay to be made. The circular gives other useful data as to badges, registration, etc., and includes a useful little map, showing the location of every scheduled hotel, and the distance along the ocean front and boardwalk in 1,000 feet spaces.

The Annual Report of the General Electric Company.

The fourteenth annual report of the General Electric Company, Schenectady, N. Y., for the year ended January 31, 1906, has been presented to the stockholders. The profits of the company for the past year (including $173,389.52 from securities sold, and $798,539.27 from royalties, dividends and sundry profits), after deducting all patent, general and miscellaneous expenses and allowances for depreciation and losses, and $1,838,362.46 from factory plants and machinery, were $7,319,160.61. There was paid in dividends during the year $3,861,062, leaving profits for the year of $3,458,098.61. Deducting fifty per cent of the company's patent account now written off, amounting to $1,000,000, cuts the surplus for the year to $2,458,098.61. The amount of surplus at the end of the last fiscal year was $9,569,196.48, making the total surplus on January 31 $12,027,295.09.

The sales billed by the company to its customers for the past year were about $4,000,000 more than for the previous year, showing an increase in business done of about ten per cent. The foregoing data are included in the report of C. A. Coffin, president of the company.

The report of Eugene Griffin, first vice-

president of the company, shows that the total sales amounted to $43,146,902. The total orders received amounted to $50,044,272. Orders for heavy traction motors include machines from 125 horse-power to 200 horse-power capacity. These are being used on the Manhattan Elevated and the Interborough Rapid Transit Company's system, New York city; the Underground Electric Railway Company, of London; the Great Western, of London; the Northeastern Railway, Newcastle, England; the Metropolitan Underground and the Paris-Orleans Railway, Paris. In all these cases the motors are operated in conjunction with the Sprague-General Electric train control system. During the year orders were received for over 300,000 horse-power of such motors. The orders for all railway motors for the year amounted to about 750,000 horse-power. On January 31 there were 4,026 cars equipped with the Sprague-General Electric train control.

Up to February 1, 1906, the company had received orders for 535 Curtis turbines, and had shipped to customers 346. During the past year, in addition to sales of 214 turbines to domestic customers, orders were received for forty-four turbines from eleven of the principal foreign countries.

In August, 1904, the company placed in operation between the cities of Schenectady and Ballston, N. Y., a car equipped with single-phase motors constructed to operate with either direct or alternating current, and also to change while running at high rates of speed from one current to the other. Since that time many contracts have been taken for the equipment of railways with single-phase, alternating-current apparatus. Among these are the following: Pontiac & Joliet Railway, Toledo & Chicago Interurban Railway, Milwaukee Electric Railway and Light Company, Central Illinois Construction Company and Richmond & Chesapeake Bay Railway Company.

Orders have been received for thirty-five 100-ton locomotives for the operation of the New York Central terminal. This locomotive has, during the past year, undergone a mileage test conducted by the officials of the railroad company on its tracks west of Schenectady. On January 31 the total mileage was 29,568. The total maintenance cost, as reported by the New York Central company, is about one-fourth the average maintenance cost of the steam locomotive.

During the year there were received about 208,229 separate supply orders (not including contracts), an average of 694 per working day.

The outlook for the coming year is promising. The orders for February and March exceeded the orders for the same months of 1905. There is every indication that business for this year will tax the maximum factory capacity to the utmost. The unfilled orders at the present time are considerably in excess of such orders at any other date in the history of the company.

The report of E. W. Rice, Jr., third vice-president of the company, shows that expenditures aggregating $2,338,362 have been made during the year for real estate, erection of new factories, extensions to existing buildings, additional machinery, patterns, special tools, furniture, etc. The floor space occupied is about 4,350,000 square feet, and there are employed about 22,500 hands. The land area of the Schenectady, N. Y.; Lynn, Mass., and Harrison, N. J., factory plants is about 439 acres. The total book value of these plants, including both land and buildings, is $4,843,812.88, or about $1.10 per square foot of manufacturing floor space.

At Schenectady a building of 23,000 square feet has been erected for use as an armature and tinsmith department. Several other buildings aggregating 33,000 square feet have also been constructed. There are now under construction, and nearly completed, a brass foundry and additions to the iron foundry and pattern storage buildings amounting to 113,000 square feet.

At the Lynn, Mass., works there has been completed a blacksmith shop containing approximately 16,000 square feet. About 92,000 square feet have been added to existing buildings. There are under construction buildings for the manufacture of railway and stationary motors, transformers, etc., containing about 177,000 square feet. An extension of 45,000 square feeet is being made to the turbine building.

The Edison Electric Company, of Los Angeles, Cal., is installing four 7,000-horse-power General Electric generators on the Kern river to transmit electric power a distance of 115 miles to Los Angeles.

The size of transformers used in raising and lowering the voltage in alternating-current work is steadily increasing. The company is now regularly manufacturing units of 10,000-horse-power capacity.

The line of steam turbine generators has been extended and improved. The company has designed and sold a number of turbines of 12,000-horse-power rating, each capable of delivering a maximum output of some 18,000 horse-power.

The company has delivered to the New York Central & Hudson River Railroad four of the eight 7,000-horse-power turbo-generators ordered last year.

An important contract which has been undertaken is for the electrification of the West Jersey & Sea Shore Railway between Camden and Atlantic City, N. J., a distance of sixty-four miles.

The consolidated balance sheet is as follows:

CONSOLIDATED BALANCE SHEET OF JANUARY 31, 1906.

ASSETS.

Cash		$6,356,093.77
Stocks and bonds	$19,104,539.30	
Real estate (other than factory plants)	359,013.86	
Notes and accounts receivable	16,287,018.01	
Work in progress	2,496,205.78	
	38,246,776.95	
Merchandise inventories:		
At factories. $14,983,710.46		
At general & local offices 1,782,678.47		
Consignments 155,901.91		
	16,922,290.84	
		55,169,067.79
Factory plants	8,000,000.00	
Patents, franchises and goodwill	1,000,000.00	
		9,000,000.00
		$70,525,161.56

LIABILITIES.

3½ per cent gold coupon debentures	$2,047,000.00	
5 per cent gold coupon debentures	55,000.00	
Accrued interest on debentures	458.33	
Accounts payable	2,106,863.89	
Unclaimed dividends	1,794.25	
		$4,211,116.47
Capital stock		54,286,750.00
Surplus		12,027,295.09
		$70,525,161.56

HENRY W. DARLING, *Treasurer.*
EDWARD CLARK, *General Auditor.*

CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1906.

EXPENSES.

Cost of sales (including depreciation of plants, $1,838,362.46)	$37,025,346 61
Interest on debentures	75,105 54
Profit for the current year	7,319,160 61
	$44,419,612 76
Patents written off	$1,000,000 00
Dividends paid in cash	3,861,062 00
Surplus at January 31, 1906, carried forward to next year	12,027,295 09
	$16,888,357 09

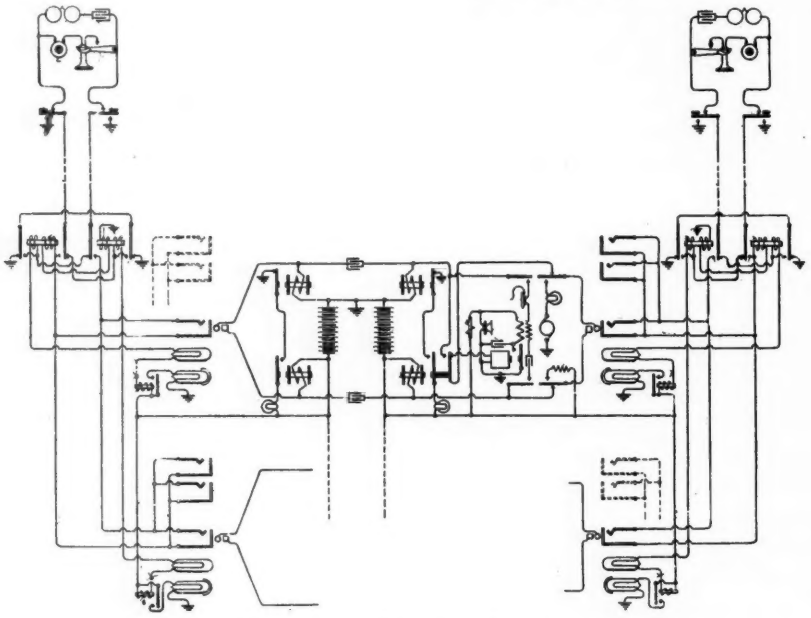
EARNINGS.

Sales		$43,146,902 42
Royalties, dividends and interest on stocks and bonds, and sundry profits	$798,539 27	
Interest and discount	300,781 55	
		1,099,320 82
Profit on sa es of stocks and bonds		173,389 52
		$44,419,612 76
Surplus brought over from last year		$9,569,196 48
Profit for the year ending January 31, 1906		7,319,160 61
		$16,888,357 09

HENRY W. DARLING, *Treasurer.*
EDWARD CLARK, *General Auditor.*

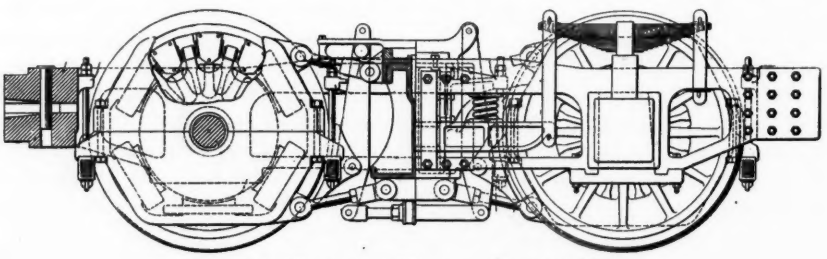
Electrical Patents.

An improved two-division telephone system has been invented by Howard M. Post, of Chicago, Ill., and he has assigned the same to the Kellogg Switchboard and Supply Company, Chicago, Ill. (816,819, April 3.) This invention relates to a divided multiple switchboard system, the object being to provide a system of this type in which the sources of energy are all located at the central office in which a minimum amount of apparatus for each line is required, and in which only two wires extending throughout the switchboard are employed for each line, and, further, to provide in such a system suitable apparatus for connecting the subscribers together and for properly supervising and attending the connections. The apparatus is so arranged that but two relays are required for each line at the central office, whereby the great saving results in the cost of installation and maintenance. The subscribers have two push buttons corresponding to the two divisions, whereby they are enabled to operate their signal upon either board. The signals are arranged to be locked in operating position as soon as the push buttons are operated, whereby the signals remain exposed until the operators answer, even though the push buttons be released. The circuits are arranged for the ready application of pilot signals without complication of parts. The invention consists in the combination with a metallic telephone line, of two signals therefor at the central office located upon different divisions of the switchboard, a central source of current with which the line is connected at the central office, two relays for the line adapted to be operated from the source, means at the substation to cause the operation of the relays singly, a cord circuit at the central office to establish connections with the line of conversation and means for including the source of both relays in a local circuit including a portion of the talking circuit when a connection is established for conversation, whereby the relays are operated to render the signals inoperative during a connection and the source is included in the metallic circuit of the line to furnish current for conversation.



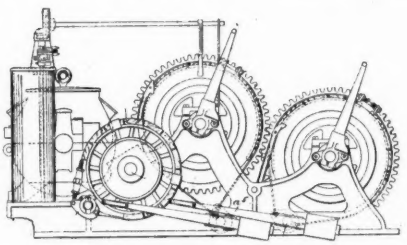
TWO-DIVISION TELEPHONE SYSTEM.

Charles A. Psilander, of Pittsburg, Pa., has obtained a patent (816,600, April 3) for an improved suspension means for electrical railway motors, and he has assigned the same to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. This invention relates to suspension means for electric railway motors of the class in which the armature of the motor is mounted upon or surrounds the driving axle. The object of the invention is to provide such means for supporting a large part of the weight of the motor on the truck frame that the motor shall be substantially independent of all distortions and tilting movements of such frame and the motor bearings shall be relieved of the weight of the field magnet frame. The invention consists in the combination with a truck frame, a driving axle, a motor armature flexibly mounted thereon and a field magnet frame surrounding and having bearings for said armature, of lugs integral with the motor frame, leaf springs having their ends secured to the truck frame and their middle portions secured to the lugs, and links attached respectively to the upper and lower sides of the motor frame and to the truck frame.



SUSPENSION MEANS FOR ELECTRIC RAILWAY MOTORS.

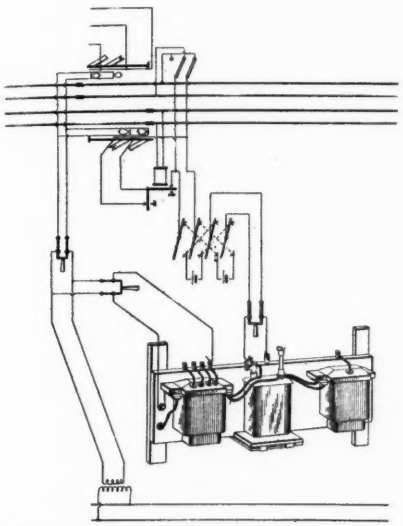
Almon E. Norris, of Cambridge, Mass., has obtained a patent (816,879, April 3) for an improved electrical hoisting apparatus. This invention relates to hoisting mechanism and particularly to hoisting machinery employing electricity as a motive power, although in certain respects it may have application to other uses. The invention consists in the combination with a bed-plate, of a plurality of hoisting drums mounted thereon at one end of the bed-plate and an electric driving motor mounted at the other end thereof, an intermediate countershaft geared to the motor and also geared to said drums, and load-holding means upon said countershaft.



ELECTRICAL HOISTING APPARATUS.

Asbury G. Wilson, Wilkinsburg, Pa., has obtained a patent (817,827, April 17) for an improved system of charging storage batteries, which he has assigned to the Union Switch and Signal Company, Swissvale, Pa. The invention relates more particularly to railway signaling systems wherein electric currents are employed as

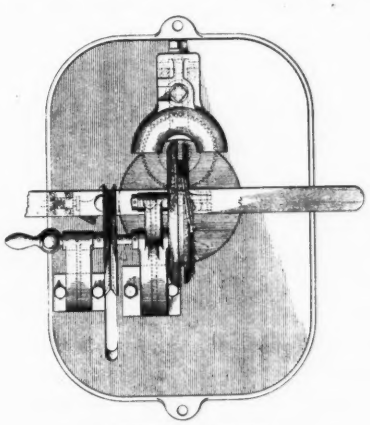
the motive power for operating the translating or other devices and apparatus in the signaling system, and in the present instance it is more particularly intended for use in connection with those systems employing storage batteries as the source of current supply for the translating or



System of Charging Storage Batteries.

other devices and apparatus used in the signaling system. As the primary source of electric supply an alternating current is preferably used, and means for charging or transforming such alternating current into a unidirectional current is employed. Any suitable transforming device may be used, and in the present instance is shown one commonly known in the art as a "rectifier." This transforming device is commercially known as an "alternating-current rectifier," and in the present invention it is connected with the mains or feed wires on which alternating current of high voltage is impressed, such current being changed or transformed within the rectifier into a unidirectional current and fed to suitable batteries conveniently situated between the rectifier and the signals, and from which current is supplied to the translating or other devices, apparatus and to the railway signal operating mechanisms and track circuits of the signaling system. One of the objects of the present invention is to provide storage batteries in a railway signaling system and to charge such storage batteries by a unidirectional current obtained from an alternating current, feed wires which may extend from the storage batteries to the circuits of the signaling system, and resistances or other devices may be used in any circuit where it is desired to reduce the voltage or current, or both, supplied from the storage battery. The invention further contemplates the use of suitable transformers having the usual primaries and secondaries, a current from the main feed wires being impressed in the primary and induced in the secondary, whence it flows through proper wires to the lamps for lighting the railway signal. Appropriate controlling switches are also contemplated for use in connection with this invention.

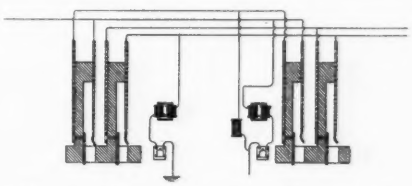
Edwin H. Smythe, Chicago, Ill., has invented certain new and useful improvements in winding machines, which he has assigned to the Western Electric Company (817,883, April 17). The invention relates to a winding machine, being designed more particularly for winding wires upon closed ring cores such as are used for the so-called "loading coils" of telephone circuits. It is the object of this invention to simplify the construction of machines of this character, so that they will be cheaper to build and will have a large capacity for wire in proportion to the size of the aperture in the ring core



Winding Machine.

to be wound. One of the distinctive features of this machine is that the guide ring is entirely dispensed with, the guide being carried upon the spool ring, which is directly driven instead of being merely rotated by the pull of the wire. The guide has a relative movement of rotation with respect to the spool ring, which movement may be opposed by friction. As the spool ring is positively rotated it tends to carry the guide around with it, pulling off the wire from the spool, the rate of slip of the guide relative to the spool ring being determined by the rate at which the wire is being pulled off.

Milo G. Kellogg, Chicago, Ill., has obtained a patent (817,781, April 17) for an improved multiple switchboard for telephone exchanges. This invention relates especially to a telephone exchange system in which part of the lines are ground circuit lines and part of the lines are metallic circuit lines, in which each line is permanently grounded at the central office through its annunciator; and it consists of a system of calling, testing, switching and clearing out for such an exchange. The invention comprises in a telephone exchange system, multiple switchboards, telephone lines connected to the same and permanently grounded at the central office, switch apparatus by which any two lines may be connected together for conversation, and test-receiving instruments, one at each board, in combination with test wires or circuits, one for each line, each



Multiple Switchboard for Telephone Exchanges.

open to the line, extending to all the boards and connected through an individual resistance coil to one side of each test-receiving instrument, apparatus and connections by which any two of said test circuits are connected together through a test battery when their lines are connected together for conversation and plugs or devices, one for each test-receiving instrument, each connected to the other side of its instrument and adapted to be brought into connection with any test circuit. This invention was assigned to the Kellogg Switchboard and Supply Company.

Electrical Supply Houses Invading the Banking District

The April issue of *Our Neighbor*, a monthly mercantile and banking magazine, contains the following paragraph: "Several of the local electrical supply houses are moving into the B. L. banking district, and it looks as though this will soon be the coming electrical business section of the city. The Electrical Club, of New York, which has recently been established, also has its clubrooms in our immediate vicinity. The firms which will remove their offices during this and next month are the following: Manhattan Electrical Supply Company, from 32 Cortlandt street to 17 Park place; Stanley & Patterson, from 40 Cortlandt street to 27 Warren street; Western Electric Company, from 22 Thames street to 17 Murray street, and E. B. Latham & Company, from 39 Vesey street to 4 Murray street."

The India Rubber and Gutta Percha Insulating Company has also removed to 253 Broadway, corner Murray street.

The Faraday Society.

The nineteenth ordinary meeting of the Faraday Society was held on Tuesday, April 10, 1906, at the Institution of Electrical Engineers, 92 Victoria street, London, S. W. Professor A. K. Huntington was in the chair.

Mr. F. W. Harbord communicated to the meeting papers by Messrs. Keller, Stassano and Gin. The paper by M. Ch. A. Keller was entitled "Electrothermics of Iron and Steel."

The author deals with the present position of his processes; he describes the electrical steel plant which Messrs. J. Holtzer & Company have just installed in their works at Unieux (Loire). This is a 1,500-horse-power plant, and will utilize in a single furnace the current from a 20,000-ampere Westinghouse alternator. The furnace, which rests on a steel cradle and can be tilted, weighs about 50,000 kilos; the various mechanical and electrical controls are obtained by hydraulic motors. The steel obtained from a Siemens-Martin furnace will be run into the electric furnace immediately after the oxidizing melt, and for the remaining operations of deoxidizing and refining, the current exclusively will be used. It will be possible to operate on 8,000 kilos of metal at one time, and the operation will be repeated three or four times in the twenty-four hours. The steel produced by this furnace is intended for cannon and projectiles. The author promises at a future date to furnish details of the results obtained.

Some experiments made at Livet comparing the metal obtained in a 1,000-horse-power Keller furnace with that obtained in the blast furnace are further described, and curves are given showing the proportions of carbon and silicon in castings produced in both ways. It appears that the Keller furnace allows of ready desulphurization and of easier variation in the proportions of the above elements than does the blast furnace; it would thus be advantageous for the production of soft castings and castings for mill work. Tests on some of these electrothermic castings are described.

The author has just set up at Livet a 2,000-horse-power furnace utilizing a current of 25,000 amperes, and capable of producing twenty tons of castings in twenty-four hours. This will be used specially for the industrial working of the process. Further details respecting the new furnace are promised.

Mr. W. Murray Morrison referred to the freezing of the metal in the central passage in the first furnace that had been erected, and asked for further information regarding the easy variations in silicon content claimed by the author.

Mr. F. W. Harbord said the freezing trouble was probably only due to the special conditions of the first tests recorded, and in any case could be avoided by coupling two or four furnaces together. Regarding variation of silicon content, as a rule this was easily brought about by adding a little silicon pig, but it might conceivably, under special circumstances, be useful to vary it in the way described for the production of good castings.

Professor A. K. Huntington described some experiments he carried out in 1881 with the Siemens electric furnace in which he was able to vary the silicon content from one-quarter to nine per cent. He had also succeeded in volatilizing copper and in making solid tungsten.

The paper contributed by Cav. Magg. Ernesto Stassano was entitled "Note on the Rotating Electric Steel Furnace in the Artillery Construction Works, Turin."

The furnace described and illustrated in the paper is being installed by the "Forni Termoelettrici Stassano" Company for the Italian war office. It is of the author's well-known arc type, and absorbs 140 kilowatts yielding 2,400 kilos of steel in twenty-four hours. The current is a rotary one with eighty volts between each phase. The consumption of electrodes is under five kilos per ton of steel, and the cost of renewing the refractory covering of the furnace ten francs per ton of metal made. The furnace is principally used for refining pig iron and smelting scrap. The product ordinarily made is used for artillery projectiles.

Mr. W. Murray Morrison thought the efficiency would not be so great as with the Keller or Héroult type.

Professor A. K. Huntington asked whether there would not be greater consumption and wear of electrodes if they were touching. He did not consider the process offered any special advantages for ordinary steel making.

Dr. H. Borns asked whether Stassano always used very pure iron ore from Elba and other Italian mines.

Mr. Charles Weiss pointed out that the paper did not state whether steam or water power was used in the Turin works. He thought that in countries like South Africa where water power was available and there was plenty of rich ore, it might be useful to smelt copper ores in the electrothermic furnace.

Mr. F. W. Harbord said the efficiency as stated was somewhat greater than in the other furnaces. For special castings there might be advantages in heating by radiation only. The figures given for carbon consumption were smaller than in the Keller or Héroult furnaces. He thought the rotation was the weak point in the furnace.

With regard to the general question of electric steel smelting, a maker had recently told him that he had sold 300 tons of such steel as crucible steel, and the buyers were so pleased with it that they were asking for more. That was strong evidence that good steel could be made in the electric furnace, but it was only high-priced steel that could be commercially made (in England) by such means.

Mr. Harbord then read M. Gustave Gin's "Note on Recent Developments in the Gin Electric Steel Furnace."

The author's canal-type of furnace is now installed at the Plettenberg Works, Westphalia, of which illustrations are given in the paper, but it is not stated which particular type of furnace has there been experimented with. The following types are described:

(1) Furnace with Canals and Chambers —Unlike in the canal form originally suggested, the electrothermic heating and refining now take place separately, the latter in chambers which communicate with each other and with the leads by the canals, now used exclusively for heating. The construction of a 7,200-kilowatt furnace, utilizing 60,000 amperes at 120 volts and designed to yield over 350 tons in the twenty-four hours, is described in detail. The author claims that the furnace combines the advantages of the Martin and Talbot furnaces, the separation of the operations making exact control of composition possible.

(2) Combination Furnace—This consists of a melting and oxidizing crucible, a deoxidizing and recarburetting compartment, and a final mixing chamber, and is fully described and illustrated in the paper.

(3) Induction Furnace—The author's suggestions for various types of induction furnace are described. The use of multiple canals is proposed, so that if steel is being produced, oxidation can be carried out in one canal and reduction in the other. In another suggested type, more intimate circulation and mixing of the product is brought about by means of lateral conduits connecting the respective ends of the open flues of which the channel crucible is made up.

The paper by Mr. H. S. Coleman entitled "Notes on the Cleaning of Work by Means of the Electric Current" was communicated by Dr. F. Mollwo Perkin.

The work to be cleaned (usually pre-

paratory to electroplating) is suspended in a hot solution of equal quantities of brown Montreal potash and sodium hydrate contained in a wrought-iron tank. The work and the tank are connected to a dynamo, and the tank used as the anode for five to ten minutes, the voltage being about 2.5. The current is then reversed for a short time, until the surface of the work is clear and bright. The operation is repeated as many times as may be necessary. The process causes the grease, consisting chiefly of tallow, to become saponified and go into solution. The lighter dirt is thrown upon the surface of the bath and may be skimmed off; the remainder falls to the bottom. In conclusion the author points out the economies affected by the process as against hand-scouring.

Single-Phase and Continuous-Current Equipment for Limited Schedule Speeds.

An investigation has been made by Mr. H. M. Hobart into the capabilities of the single-phase commutator motor, with the object of comparing this motor with the standard direct-current railway motor. Some time ago Mr. Hobart stated that he had come to the conclusion that the total weight of electrical apparatus necessary for a single-phase equipment is well on toward double the weight of that of the continuous-current equipment. Since then he has made a more complete study, says the *Tramway and Railway World* (*London*), and has plotted a large number of curves showing the relation between the normal speed of a locomotive and preferable driven wheel diameter, motor speed and weight, the relation between maximum speed and rate of acceleration for various schedule speeds, acceleration curves and curves of energy consumption for the two types of motor. The chief conclusion arrived at is that the continuous-current motor has a capacity for high acceleration during the initial stage of a run far in excess of that of the single-phase commutator motor. It has this same inherent capacity up to full speed, but out of consideration for the generating and transmission system it is not expedient to make use of it. However, it will not be any more expedient to do so in the case of the single-phase commutator motor, for in either system it will involve heavy momentary demands upon the generating plant and line, and it is in the interests of economy and capital outlay and running costs to avoid heavy momentary peaks of load. The inferiority as regards the attainable schedule speed for services with frequent stops is but one among several disadvantages of the single-phase commutator motor as at present developed, but this disadvantage has probably been less carefully analyzed from the standpoint of the elementary speed time diagram. The author's later investigations have confirmed his opinion regarding the comparative weights of the two systems stated above. He believes that the sound engineering solution of heavier traction problems will eventually be found in the employment of higher voltage, continuous-current systems. Mr. Hobart calls attention to the distrust felt for commutators some years since, and says that the new motor does not solve this problem, for by halving the voltage the size of the commutator must be doubled, and twice as many brushes be employed. He believes that increasing the voltage, which enables a smaller commutator to be used, is the proper way out of the difficulty. While 500 volts is the preferable pressure up to fifty horse-power, motors of several hundred horse-power may for a given rated output be designed for better commutation when a higher pressure is employed at the commutator.

Portland, Ore., Electric Notes.

One of the largest deals in electric railway and power properties in the history of the Pacific northwest was consummated at Portland on April 30 when the Portland General Electric and the Portland Railway companies, purchasers of the Oregon Water Power and Railway Company, installed their directors and officers and took control of operation. The new officers are: president, H. W. Goode; vice-president, F. I. Fuller; secretary and treasurer, C. N. Huggins; general manager, W. H. Hurlburt. Messrs. Goode, Fuller, Huggins, O. F. Paxton and S. J. Reed are the new directors. Mr. Goode is president of the Portland General Electric Company; Mr. Fuller is president of the Portland Railway Company; Mr. Reed is secretary of the Portland General Electric, and Mr. Huggins is in the office of the same company; Mr. Paxton is counsel for the Portland Railway Company. Mr. Hurlburt has, since the inception of the Oregon Water Power and Railway Company, been its president and manager, and he has consented to remain with the new owners. They take over approximately ninety miles of electric railway, extensive terminals and docks in Portland, and a power plant under construction at Cazadero, on the Clackamas river, thirty-five miles from Portland, where machinery is now being installed to generate 15,000 horse-power, to be used in operation of the road and for general lighting and power purposes in the city of Portland and adjacent towns.

The amount involved in the transaction was about $5,500,000, of which $1,225,000 was paid for the $2,000,000 capital stock of the company, and the remainder represented the assumption of the bonded debt of $4,225,000 by the new owners. The Portland General Electric is said to have been the principal buyer. It is the purpose of this company to develop one of the most extensive electric lighting power systems in the United States. It will cover the Willamette valley in a radius of seventy-five miles around Portland.

Technical Publicity Association.

A meeting of the Technical Publicity Association was held at the Aldine Association rooms, Thursday evening of last week. After the usual business meeting, which was held at 6 o'clock, a dinner was enjoyed, with a number of publishers as guests, and Mr. John A. Hill, president of the American Trade Press Association, delivered an able and interesting address. Others were called upon by the president of the association, Mr. F. H. Gale, and responded briefly.

Among those present were: John A. Hill, F. H. Gale, H. M. Davis, W. S. Bullock, Charles W. Price, Rodman Gilder, T. E. Crossman, F. S. Wayne, I. S. Holbrooke, Charles N. Manfred, C. A. Baptiste, M. Estabrook, Harvey Mansfield, A. E. Clifford, P. S. Dodd, P. W. Wade, E. A. Simmons, W. J. Johnston, H. H. Kress, V. H. Martyn, A. N. Barber, G. J. Williams, J. W. Smith, F. R. Davis, A. H. Stein, Frank Dampman, Dean Park.

Another Alpine Tunnel.

Consul Keene writes from Geneva that the Simplon tunnel is about to be opened to traffic, and the subject of the lines of access to the new international railroad is being constantly discussed in Switzerland.

Besides the "Faucille" line through the Jura range, near Geneva, which has been talked about for years past, a new tunnel through the Bernese Alps between the canton of Berne and the canton of Valais, from which the Simplon line passes to Italy, is under active and practical consideration. The board of directors of the committee having that new enterprise in charge, held a general meeting on March 5 and unanimously approved the project submitted by Chief Engineer M. Zollinger for a line to pierce the Bernese Alps under the Lotschberg. Electrical traction will be used, and the new tunnel will be eight and two-fifths miles long. The total cost is estimated at $16,984,000 at the outside.

A Franco-Swiss syndicate of leading bankers and engineers, at the head of which is the firm of J. L'Hoste & Company, of Paris, has pledged itself to submit within two months from now its formal contract for executing the work.

Reviews of Current Engineering and Scientific Literature.

System in Wiring Work.

When one considers the difference occasionally observed in the estimates submitted by various contractors for doing certain classes of work, it leads to some conjecture as to how the estimates are arrived at. Of course, fifteen or twenty per cent difference is not of much account, but when the estimates sent in by different firms in the same locality vary by 100 per cent, it is evident that there must be something wrong. It can scarcely be questioned that a systematic method of carrying a job through will allow the original estimate to be reduced by a large amount. A favorite idea with a good number of contracting firms is to secure a staff and train it into its methods, but it is the staff which occasionally pulls the governor around to its way of thinking. The first and most important point is to secure not cheap men, but good methodical men capable of leaving a clean, firm job behind them. The man who knows he is competent will never accept a less rate than his fellow workmen. Of course, there are hundreds of men who will never get beyond the detail stage, but always, provided they are capable of this, they are of as much value to an employer on simple wiring work as a man capable of taking control. Secondly, it is a very important matter to have all material promptly sent on the job when required. Even in well-managed firms it is not unusual to have to find work for men elsewhere pending the arrival of some particular size of tubing or character of junction boxes. A duplicate order book, hung up in the stores or office in a prominent position, will work wonders in this respect. Thirdly, it should be remembered that there is such a thing, even in wiring work, as an artistic way of finishing off a job. Fourthly, the importance of labor-saving devices should be recognized. Fifthly, a charge hand should always know exactly what material and how much he has on hand. There is one abomination in particular beloved of lazy wiremen. This consists of a large box which originally contained material consigned direct to the job. This is the beginning of its evil career: if a holder won't screw up nicely or a coil of flex becomes tangled it is forthwith consigned to this box. Next step: somebody fixes hinges and a padlock minus a key on it. Then a chaotic mixture of ceiling roses without covers, screws, nails, tape, augurs, bottles and overalls fills the box. Orders come piling into the office for material, of which plenty may be found on the job. One good man should be put in charge of the material. He should keep it in one room, and see that it is properly sorted out when returning for credit. Screws constitute another source of trouble. Workmen should be supplied with the exact gauge screw required. On account of the difficulty of getting a screwdriver into the slot of a round-head cap screw, nine out of ten wiremen hammer them in all the way. Of course, flat-head screws are sometimes hammered in also when nobody is looking, but a decent workman will, even if he does use a hammer, give his screws a twist or two to tighten them up thoroughly. The sixth requirement is an important one; that is, a good system of timekeeping. Perhaps the best all-around system for wiring firms would be to have all workmen call at stores or offices at whatever hour the day begins. This has the advantage of keeping the office in touch with the men. If a time-recording clock is not installed, a time book should be made use of. Thus it may at any time be possible to find a particular man when required. The daily time sheets should be carefully watched, and each man made to keep the weekly time sheet in perfect order.—*Abstracted from the Electrical Engineer (London), April 20.*

On an Emission of Negatively Charged Particles Produced by Canal Rays.

The work described in this article was undertaken by Mr. L. W. Austin for the purpose of studying the possible secondary radiations produced by the impact of the canal rays on a metal. Since it is known that the canal rays consist of positively charged particles of molecular dimensions, traveling with a velocity sometimes exceeding 10^8 centimetre seconds, it seemed probable that they might give rise to reflected positive rays analogous to the reflected cathode rays, and perhaps also to an emission of negative particles. The first observations showed that the reflection of the canal rays was entirely masked by a secondary negative emission. As the work progressed it became evident that there were irregularities in the phenomenon of a very puzzling character. These irregularities have made it impossible to carry out the work with the same quantitative exactness as in the case of cathode rays. Irregularities have also been observed by Wien in his determination of the ratio e/m for the canal rays, and it seems possible that they may arise in both cases, at least in part, from common causes. As an explanation of Wien's results, Professor J. J. Thomson has supposed that perhaps some of the positive particles have their charges neutralized by taking on negative electrons as they pass through the gas, and that they again become ionized when they strike against a solid, and are thus able to produce fluorescence. If we suppose that such neutral particles are also capable of producing the negative emission, we have a possible explanation of our irregularities. Since it is known that the negative emission produced when cathode rays strike a metal increases rapidly as the angle of incidence increases, observations were made to determine whether this was also true in the present case. It was demonstrated that the galvanometer current increases rapidly as the angle of incidence increases, being more than forty per cent greater at seventy degrees than at zero degrees. If we assume that the increase is entirely in the emission, the difference amounts to about one and one-half times. Regarding the mechanism of the secondary radiation, it is difficult to say anything with certainty. It is clear that as the radiation takes place in a space free from any differences of potential, all parts being connected to earth, the energy not only for the separation of the negative electrodes, but also for their velocity, must come from the canal rays themselves, unless we are willing to assume that their impact on the metal renders its atoms radioactive, so that the electrons are expelled by some process of explosion. The fact that the emission of the electrons is greater at larger angles of incidence is also difficult of explanation, especially in this case, when the canal rays do not penetrate the metal surface; and the explanation suggested by Professor Thomson for the increased emission at large angles due to cathode rays can not apply. We have in the emission of negative electrons by a bombardment of positive particles a condition of things very similar to that involved in the passage of negative electricity into the gas at the cathode in the ordinary vacuum discharge, as in that case also it is generally believed that the negative particles are liberated by the impact of positive particles upon the cathode. If, indeed, the mechanism of the two cases is the same, the present work indicates a means of studying the nature of this portion of the discharge in vacuum under simplified

conditions. The author summarizes his results as follows: 1—When canal rays strike an earthed metal surface there is a weak diffuse reflection of these rays; 2—There is also a diffuse emission of negative particles having widely varying velocities; 3—This negative emission increases as the angle of incidence of the canal rays increases, and is probably similar in character to the secondary negative emission produced by cathode rays.—*Abstracted from the Physical Review (Lancaster), May.*

Alcohol Calorimeter for Coal Testing.

Of the two ordinary methods of measuring the heating value of a coal, says Professor W. M. Wallace, of the School of Mines, Kimberley, South Africa, the calorimeter is by far the cheaper and quicker, and would be universally adopted in cases where the calorific value of the coal is required without reference to boiler conditions if anything approaching good percentage results were obtainable with it. To make a steam test extensive and complete operations have to be carried out, lasting over a considerable period. Accurate methods of stoking must be arrived at for the particular material used; and this involves much testing of flue gases and steam, and the constant measurement of temperatures around the plant. On the other hand, a complete determination of the percentage of water, carbon, ash and the calorific value of a coal in the laboratory by means of a calorimeter should occupy little more than half an hour. Using the well-known Thomson calorimeter of the most approved type, Professor Wallace has found that on the same coal results may easily differ by three or four per cent; and, indeed, one can hardly expect anything better when one considers the sources of error inherent in the instrument. The waste gases rising in large bubbles quickly through the water can hardly be expected to give up the whole of their heat to it. The water equivalent of the instrument can not be exactly determined, and must form an important factor. Again, burning one gramme of coal in 2,000 grammes of water gives a rise in temperature of six to seven degrees only, which means that the thermometer, if read to tenths of a degree accurately, may give rise to an error of two per cent. Remembering that radiation corrections, themselves difficult to estimate in the calorimeter, whose parts are shifted from place to place, sometimes cover several tenths of a degree, it is not surprising that the heating value of a coal may be estimated at 14,000 instead of 15,000 British thermal units. From the Thomson type of calorimeter Professor Wallace turns his attention to the calorimeter of the Carpenter type, burning the coal in oxygen gas in a small chamber surrounded by water, the expansion of which is used to indicate the heat value of the coal. Oxygen gas at constant pressure is fed into the combustion chamber, and the waste gases are passed slowly through a long worm, which is also immersed in water. The outer vessel enclosing the water has a long glass tube of fine bore attached to its top, in which the heated water expands. The special merit of this method is that the water equivalent determination is done away with, and the radiation correction more accurately applied. The instrument is standardized by burning different weights of pure carbon in it and plotting the graph, showing the relation between calorific value and rise of water in the tube. One serious disadvantage, however, presents itself in this method, which is that the determinations must all be made at the same temperature; and since no means of inserting a thermometer in the water is provided by the makers of the instrument, some uncertainty arises here. The bore of the glass tube is made so small, in order to magnify the expansion of the water, that the ratios of the readings are of the same order of magnitude that the expansion of unit volumes of water bear to each other. The very irregular expansion of water makes this a serious objection to the method, as a difference of but ten degrees in the temperature of the water for two separate determinations will make a difference of twenty-five per cent in the two readings; and since no means of accurately gauging the temperature of the water is provided, it is questionable whether the instrument as it stood could be reckoned any more accurate than the Thomson calorimeter. Professor Wallace has been engaged on some exhaustive tests of South African coal for the De Beers Company, of Kimberley, and since the changes in temperature of the atmosphere on the high veldt are very rapid and large, some remedy for this defect in the calorimeter had to be found. Obviously, some fluid whose expansion would be more uniform than that of water had to be used. After repeated trials alcohol was selected and found to give excellent results. Its expansion at different temperatures within the required range is practically constant. A further advantage is that alcohol, having a specific heat about 0.7 and a much larger coefficient of expansion, allows, by the use of a longer graduated tube, very much more accurate readings with a smaller quantity of coal. For instance, the author found that 0.6 gramme only of Welsh coal gave an expansion in the tube of more than thirty inches. The instrument, in fact, is an immense thermometer, in the bulb of which combustion of the fuel takes place. Both the weight of the coal and the readings can be obtained correct to a fraction of one part in a thousand, and for any desired degree of accuracy it is only necessary to give the radiation correction curve attention. Professor Wallace adopts the following method for securing the radiation correction. This has been found to give excellent results with alcohol as the expanding liquid. The rate of radiation per minute is taken before combustion, and with the oxygen flowing. The coal is lit, and the liquid, rapidly, but at a uniform speed, ascends the tube. Near the end of the combustion the rapid rising ceases suddenly and is succeeded by a slow crawl. The time when this occurs is noted, and afterward one-minute readings are taken until the maximum reading is reached, and ten minutes or so afterward, with the oxygen still flowing. The mean of the extreme rates of cooling is then used to correct the temperature after the rapid rise, and the top rate of cooling per minute added, successively, to the one-minute readings during the crawl until the true maximum temperature is determined. Another advantage derived by the use of alcohol is the reduced time of the test, since only about half a gramme of coal need be burned. This allows the gases to be slowly swept out of the calorimeter, and also reduces the importance of the radiation correction. Fixed to the apparatus is a tube for the collection of the gaseous products of combustion, which can be measured and analyzed in a few minutes. With the aid of this apparatus a determination of the calorific value, ash, water, carbon and hydrogen can be made in half an hour.—*Abstracted from Engineering (London), April 20.*

The Chinese Government has arranged to establish several stations throughout China for experiment with Marconi's system of wireless telegraphy and instruct Chinese operators in working the same. The apparatus has been installed on four Chinese men-of-war at Shanghai and at the three north China cities of Tientsin, Peking, and Paotingfu, the radius of action being about two hundred and thirty kilometres. An Italian officer has been appointed, not only as instructor, but also as engineer to superintend the installation, and under whom a number of students have already been detailed to act as operators and learn the art of management.—*Telegraph Age.*

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

At the recent meeting of the Iowa Electrical Association, at Des Moines, O. E. Brownell, lessee of the Lake City Electrical Company, gave some practical suggestions to managers of small central stations in a paper entitled "Ways and Means of Increasing Business in Towns of Under 5,000 Inhabitants." The following abstract of his paper will be found of interest.

Under the subject of gaining the confidence of the people, I will first explain that I place more stress upon uninterrupted service than I do upon collecting for said service, as there is nothing more soothing to my enthusiasm while soliciting an intended victim than to have him refer to the frequency of interrupted service due to a shutdown.

Again, in the line of keeping the confidence of the customer, I would mention that I find it very gratifying to him to receive prompt attention on his reporting any local trouble. If he sees that you are exerting yourself to see that he receives what he is paying for he feels pleased with your efforts, and while he may not so express himself to you, he will almost invariably do so to his neighbor.

Another point in this same line is to cultivate the confidence of the public by taking precautionary measures, such as storing enough coal each fall to tide you over any snow blockade or coal shortage ever known in that locality. In this connection I would also mention that previous to April 1, I commenced storing coal, while at the same time I kept an eye open to see how much coal the railway companies were storing (and there is no better barometer for this purpose), and as I learned that they were stocking up for from sixty to ninety days after April 1 I went them one better and laid in a four-months' supply of coal, and as soon as the mines were shut down I was asked several times each day by different customers how long I would run if the strike should last, and as we do the pumping of the city water supply, one could notice a look of surprise as well as of satisfaction upon their being told that we were good for four months.

Another point in line of public confidence I would like to mention is, "do not allow the people in general to become imbued with the idea that whoever is at the head of the business is not well posted." As you are all well aware, as a rule in small towns the topics of the day with one man are very apt to be the same with his neighbor, and if you fail to convey the idea that you are reasonably well posted in your line you will find that you will lose ground in your efforts to secure new business.

Under the head of advertising I must admit that I have never tried any newspaper advertisements, and from my view of the average citizen I believe that it would be useless. However, in the line of silent or masked advertising, I will say that I believe I derive gratifying results.

In this I believe it well for the one in charge to look over his customers and select one or more prominent business men who are good talkers and convincing to the public in any argument or reason they may entertain. For our cause a druggist who is well posted in chemistry is the most desirable man. Grant him favors of a small nature and at the same time converse with him on all up-to-date electrical appliances. Get him interested in keeping posted in your line of improvements and make him the first one to exhibit your new introductions; if it would be to your interest install the new idea with him free of charge for a short time. It will attract attention, draw him trade, and the first thing you know he will be found explaining the convenience, safety, reliability and gratifying results enjoyed by those using your lights, and this same druggist, with his knowledge of chemistry, is the very best of weapons against the invasion of gasoline gas plants, as his knowledge will make him afraid of it, and he will be only too willing to explain its dangers to his neighbors and he will invariably refer to the electric light as the safest medium of artificial light.

In combating with the gasoline medium of lighting, I take the stand that the gasoline lamp is more safe than any private gas plant, as it is built to withstand pressure, while the private gas plants are not, while personally I do not agree with myself in this matter. I find that the lamp is considered a source of a great deal of trouble and annoyance by the user, and if I can convince him the gas plant is dangerous, he will very apt be found a good customer of electric lights.

It has proven in my experience that the best results are gained by charging well for all labor and material in new work, but after you have secured your customer be honest with him and assist him in keeping his lighting expense down. Don't charge him for every little thing that you have a trivial excuse whereby you might consistently do so, but try and convince him that you wish to live and let live.

If you have a customer whom you know is having a hard time to keep his head above failure lend him a helping hand. Do all that is consistent in helping him to keep his lighting expenses down, as if this man pulls through you will find him one of your best friends, and if he does not pull through his successor will not have the excuse to turn you down on account of the large bills of his predecessor. In favoring a customer, I do not believe in cutting the rate for power furnished, but rather suggest methods whereby he will not consume so much power.

In wiring residences I try to break away from the old custom of ceiling fixtures, which must be cut short enough to allow the taller person to pass underneath them, and in their stead I recommend the ceiling cluster fixtures for general illumination of the room and a wall bracket for reading purposes, and if I can do so I prevail on the customer to use a reading lamp, and while not pleasing to the eye in the way of ornamental design, I find the "universal" portable the most satisfactory of all portables.

While the electric signs are being advertised extensively, and we are urged by writers in our technical magazines to place a great deal of stress on this branch of the business, I must confess that I am unable to pull my customer's teeth from the hold he has on the old time (local paper) advertisement long enough to tell him the benefit of my idea.

I have herein given you briefly my way of securing new business by which I have increased the number of lights wired over thirty per cent in the past twenty months in a town of 2,350 population.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Hydroelectric Power for a Big Pacific Coast Cement Plant.

The Washington Portland Cement Company's new plant, located in Skagit county, Washington, on the Skagit branch of the Great Northern Railway, between Anacortes and Rockport, about 104 miles northwest of Seattle, which was begun early last spring, is expected to be ready for operation soon. The equipment, both for power and cement making, is, in many respects, worthy of note, being furnished by a single concern, the Allis-Chalmers Company, of Milwaukee, whose hydraulic turbine will furnish power to operate an Allis-Chalmers generator, which in turn will supply current for a full equipment of Allis-Chalmers motors, mounted directly on the various machines used in the modern process of Portland cement manufacture, which are also furnished by the Allis-Chalmers Company.

It is the intention of the building company to bring the capacity of the plant up to the capacity of 3,000 barrels per day by adding two kilns at a time. The initial installation will consist of a complete machinery equipment for a two-kiln plant, using the dry process by means of water power and electrical drive. The raw material to be used consists of limestone and shale, the former located in deposits 1,500 feet from the plant and the latter 500 feet, both connected by an electric road over which the material will be transported. The company has three side tracks from the main line of the Great Northern to the works. A dam across the Baker river, at a distance of a mile from the power plant, is being constructed to be connected by a flume six by ten feet from the dam to the power-house. The Baker river flows in a southerly direction at the point where the dam is being built and the flume follows the east bank, the flume intake being close to the bank and immediately above a small island in midstream. The water power, which is capable of developing 3,000 horse-power, will operate a 1,150-horse-power Allis-Chalmers twin turbine with centre disks and Cantilever type bearings from a fall of fifty feet. The discharge will be 250 feet per second and the speed 360 revolutions per minute.

For convenience in the operation of the various processes of cement making the equipment has been laid out in different groups or plans known, respectively, as the raw material plant, calcining plant, clinker grinding plant, stock house, etc., each of which has its own peculiar equipment.

The raw material plant will contain a Gates crusher with a capacity of from twenty-five to fifty tons per hour; a Gates elevator; a Clay disintegrator; an elevator and a five-foot by fifty-foot rotary dryer. An automatic weighing machine of seventeen tons capacity will be installed here; also two Gates ball mills and three five-foot by twenty-two-inch Gates tube mills.

The calcining department equipment will consist of two feeders for the rotary kilns, two seven and one-half-foot and six and one-half-foot by 100-foot rotary kilns of the heaviest design, one four and one-half-foot by thirty-foot rotary cooler and an oil-burning equipment which will consume from 350 to 400 gallons of crude oil per hour for firing the kilns. The two 100-foot rotary kilns will be supplemented by two additional kilns of the same kind as soon as the plant has been in operation for a short time.

The clinker grinding plant equipment will comprise two ball mills, two five-foot by twenty-two-inch tube mills and one gypsum feeder. The stock house will have an equipment of various kinds of feeders and elevators for conveniently handling the stock.

Each principal machine, such as the crusher, disintegrator, dryer, ball mills, tube mills, etc., will be driven by direct-mounted individual Allis-Chalmers motors. The auxiliary machinery, such as the elevators, conveyors and feeders, will be driven in groups by Allis-Chalmers motors. As far as possible the object has been to avoid the use of shafting, belts and pulleys.

Motors of twenty horse-power or over are Allis-Chalmers type "H," not enclosed, and the smaller motors are type "B" and enclosed. The electrical equipment will be very complete. The generator direct-connected to the turbine will be a 750-kilowatt Allis-Chalmers, water-wheel type alternator, three-phase, sixty cycles, 600 volts, excited from a direct-coupled exciter of twenty kilowatts capacity. There will be thirty-four induction motors installed in capacity from one and one-half to 100 horse-power and aggregating 870 horse-power. In addition to the interior equipment for the mill, an electric locomotive will operate between the mills and the shale and limestone deposits. The locomotive will haul sixteen one and one-half-yard cars and be capable of a speed of six miles per hour. The company intends to erect lime kilns for the production of lime for the Seattle market.

Mr. N. L. Warford, late of the Standard Portland Cement Works, of Napa Junction, Cal., is superintendent of the plant. The following persons are officers of the company: A. W. Middleton, president; A. S. Austin, vice-president; S. M. Anderson, treasurer; E. E. Caine, secretary, and E. C. Miller, general manager. One hundred men are employed at the present time on the construction of the plant.

Producer Gas Power Plant.

Producer-gas power has recently been adopted by the Norton Emery Wheel Company for extending its present steam plant at Worcester, Mass. The horizontal, double-acting, heavy-duty type gas engine built by the Westinghouse Machine Company, Pittsburg, Pa., has been adopted with Loomis-Pettibone producers using bituminous coal.

The new gas engine will be 500 brake-horse-power rated capacity, direct-connected to a Westinghouse 250-volt, 300-kilowatt generator running at a speed of 150 revolutions per minute. This unit will operate in parallel with two belted steam units, the entire plant supplying current to the various motor drives in the factory and also for lighting.

The Westinghouse engine will be of the tandem cylinder single-crank style; water-jacketed throughout. Pistons will be supported practically clear from the cylinder by front, middle and rear crossheads. All valves are located directly in the cylinder body in a vertical line; inlet at the top and exhaust at the bottom. A sensitive governing system of the relay type places each inlet valve independently under the direct control of the governor, by which arrangement extremely close speed regulation is secured.

At the Norton company's plant the gas used will be a mixture of two gases averaging about 125 British thermal units per cubic foot. The producer process is intermittent, water gas being made during a short run, and "blast" or "air" being made while the producers are being blown preparatory to the succeeding water gas run. After a thorough cleansing in wet and dry scrubbers, the gas is sent to a

holder of sufficient capacity to secure a thorough mixture of the alternating charges of the two different gases. In this case a 20,000 cubic foot holder will be used—sufficient to run the engine for about twenty-five minutes.

Self-Starters for Alternating-Current Motors.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has placed on the market a line of self-starters for alternating-current motors.

Fig. 1 shows a self-starter for use with single, two, or three-phase motors, capable of being directly thrown across the line to start. These self-starters are designed for those installations where the motor is comparatively small, and may be thrown directly across the line to start without the intervention of starting resistance. For single-phase systems, both sides of the line to the motor are controlled. For two-phase systems, the circuit to the motor is controlled by a single-pole switch in each phase circuit. For three-phase systems, the circuit from two of the three phase wires to the motor is controlled, the other phase wire being connected to the motor directly.

The self-starter consists of a double-pole, oil-immersed, solenoid-operated switch, which may be controlled by either a pressure regulator or float switch, depending upon the system used. With a compression tank system the pressure regulator is to be used, and the motor will be stopped and started automatically at the two limits of pressure for which the regulator is adjusted. With an open tank system the float switch is to be used, and the motor will be stopped and started at the two limits of water level in the tank for which the float switch is adjusted.

The solenoid switch consists of a double-pole knife switch immersed in oil and controlled by a single-phase solenoid. The magnet frame is of cast iron and supports the entire switch. The plunger is laminated, and the design of the switch is such that it will run very cool and absorb a minimum amount of energy. The switch parts are mounted on a plate of insulating material, in turn mounted on the magnet frame. The plunger is arranged to give the switch parts a hammer blow, both for closing and opening the switch, thus ensuring positive action. On account of the small force required to hold the switch closed, the solenoid magnet does not have the objectionable feature of "humming." The oil tank is of cast iron, in one piece, and is supported from the magnet frame by a thumb nut on either side, so that the tank may be lowered away from the switch parts for inspection without disturbing any of the parts. The tank is provided with an oil gauge and should be kept nearly full of a clear mineral oil. Machine oil must not be used.

Fig. 2 shows a self-starter for use with squirrel-cage motors. These self-starters are designed for use with two or three-phase alternating-current motors, the armature of which has what is known as a squirrel-cage winding. They are arranged to start the motor with resistance in the primary circuit to the motor, and are designed for use only when the torque required to accelerate the motor is not in excess of the normal running torque, and taking approximately 150 per cent normal current to develop this torque.

For two-phase alternating-current systems the primary circuit to the motor is controlled by a single-pole switch in each

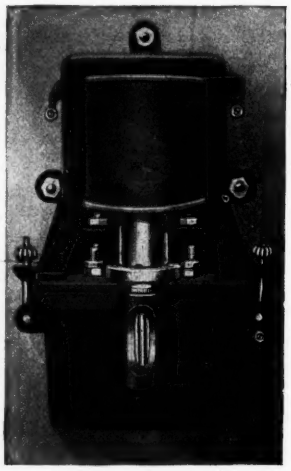


FIG. 1.—SELF-STARTER FOR SINGLE, TWO OR THREE-PHASE MOTORS.

phase circuit. For three-phase systems the primary circuit to the motor is controlled by a switch in two of the three phases, the other phase wire being connected to the motor through one arm of the rheostat lever. For two-phase systems the rheostat lever will have two arms only, operating over two sets of resistance contacts, and starting resistance will be controlled in each phase circuit to the motor. For three-phase systems the starting rheostat will have three arms, working over three sets of resistance contacts, and resistance will be controlled in three phases to the motor.

The self-starter consists of a slate panel, containing a double-pole, oil-immersed, solenoid-operated line switch, a resistance commutator and resistance, a device for moving the rheostat lever, and a solenoid for the control of this device. It may be controlled by a pressure regulator or float switch, depending upon the system used. For compression tank systems the pressure regulator is to be used, and the motor will be stopped and started at the two limits of pressure for which the regulator is adjusted. For open tank systems the float switch is to be used, and the motor will be stopped and started with the variation in water level in the tank. The motor is started by the closing of the line switch, which closes the primary circuit to the motor through the starting resistance, and thereafter the mechanical device operates to cut the starting resistance out of circuit and bring the motor up to speed. The motor is stopped by the opening of the main line switch, and thereafter the rheostat is automatically returned to the starting position, so as to be ready to start a second time.

The mechanical device for operating the rheostat lever consists of a cylinder and piston arranged for operating both ways with power, and its operation is controlled by a valve, in turn controlled by an alternating-current solenoid. Water or air at moderate pressure may be used to operate this device. Water may be taken from the city main, if desired. The solenoid which controls the valve is connected to one phase of the system inside of the main line solenoid switch. When the main line solenoid switch is energized to start the motor, this valve solenoid is energized, lifting the valve and admitting water or air under pressure to the cylinder to move the piston forward to cut the starting resistance out of circuit. When the main line switch is opened to stop the motor, the valve solenoid is deenergized, shifting the valve to the reverse position, thus returning the rheostat lever to the starting position.

The solenoid switch, magnet frame, plunger, switch parts and oil tank are the same as those shown in Fig. 1. The main line solenoid switch is electrically interlocked with the rheostat lever controlling the starting resistance, so that the main line circuit to the motor can not be closed unless the lever is in the starting position, thus providing that the motor will always be started with the proper starting resistance in circuit. This feature is also shown in Fig. 3.

The starting rheostat lever has two or three insulated arms, depending on whether the system used is two or three-phase, and controls starting resistance in each phase of the primary circuit to the motor. Contacts are of hard copper, renewable and interchangeable, and brushes are of carbon. In the running position of

the starter ample capacity is provided for carrying the motor current continuously.

As the squirrel-cage motor is wound differently for operating under different conditions, considerable care should be taken in selecting a suitable motor and a suitable self-starter for use in connection with same. When this type of motor is wound so as to operate with the highest efficiency it requires three or four times the normal current at starting to develop normal torque, while, when the conditions require that the motor develop a very large starting torque, the armature is provided with a winding having a much higher resistance, so that the normal torque will be developed at starting with approximately one and one-half times the normal running current. In those cases where the motor is not required to start under full load conditions, but where the load is thrown on to the motor after same has attained full speed, this type of motor will operate very satisfactorily and a self-starter of the same rating will give satisfactory results. If, however, the motor is required to start up under such conditions that more than the normal full load torque is required for accelerating, a larger motor should be used than is actually required to do the work at full speed, and a self-starter of the same rating as the motor is to be recommended if satisfactory results are to be obtained. With these self-starters, if the conditions are ever such that the motor does not start when the circuit is first closed, the self-starter will automatically cut out the starting resistance and gradually increase the current flowing to the motor until the motor will start. The maximum starting torque is, however, limited by the design of the motor itself, since the winding of some motors may be such that the starting torque developed will be less than the normal running torque, even when all of the starting resistance is short-circuited and the motor connected directly across the line. In those cases where the conditions of power supply are such that heavy currents can not be taken from the line suddenly, these self-starters will serve the purpose of gradually bringing the current up to the point where the motor will start, and in this way reduce materially the disturbance on the line.

Fig. 3 shows a self-starter for slip-ring motors. These self-starters are designed for use with two or three-phase induction motors, the armatures of which are wound in sections and provided with collector rings, so that starting resistance may be introduced into the armature circuit. The motors are controlled by a switch in the primary circuit to the motor stator, and are accelerated by resistance in the armature, or rotor circuit.

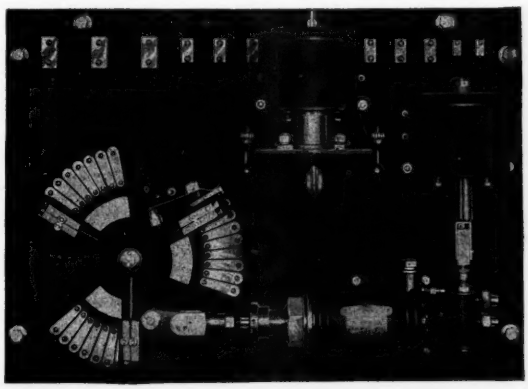


FIG. 2.—SELF-STARTER FOR USE WITH SQUIRREL-CAGE MOTORS.

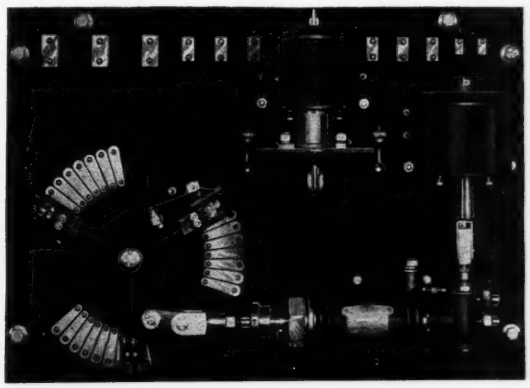


FIG. 3.—SELF-STARTER FOR USE WITH SLIP-RING MOTORS.

For two-phase alternating-current systems the primary circuit to the motor is controlled by a single-pole switch in each phase circuit. For three-phase systems the primary circuit is controlled by a switch in two of the three phases, the third phase circuit being connected directly to the motor. For either two or three-phase motors of this type it is standard practice to supply three-phase wound armatures, so that for either type of motor starting resistance will be supplied in each of the three-phase circuits of the armature.

The self-starter consists of a slate panel containing a double-pole, oil-immersed, solenoid-operated line switch, a resistance commutator and resistance, a device for moving the rheostat lever, and a solenoid for the control of this device. It may be controlled by a pressure regulator or float switch, depending upon the system used. For compression tank systems the pressure regulator is to be used, and the motor will be stopped and started at the two limits of pressure for which the regulator is adjusted. For open tank systems the float switch is to be used, and the motor will be stopped and started with the variation in water level in the tank. The motor is started by the closing of the main line switch, which closes the primary circuit to the motor, and thereafter the mechanical device operates to cut the starting resistance out of the armature circuit and bring the motor up to speed. The motor is stopped by the opening of the main line switch, and thereafter the rheostat is automatically returned to the starting position, so as to be ready to start a second time.

The mechanical device for operating the rheostat lever is the same as that shown in Fig. 2.

The solenoid switch, magnet frame, plunger, switch parts and oil tank are the same as those shown in Fig. 1.

The starting rheostat lever has three arms, cast in one piece, and controls starting resistance in the three-phase circuits of the motor armature. Contacts are of hard copper, renewable and interchangeable, and brushes are of carbon. In the running position of the starter the three collector rings on the armature are connected together, and ample capacity is provided for carrying the motor current continuously.

Pacific States Telephone and Telegraph Company Getting into Shape.

The Pacific States Telephone and Telegraph Company has a very large corps of men at work reconstructing its system in San Francisco, Cal. The telephone company sustained a loss of about a million dollars in excess of its insurance. The territory destroyed contained about 33,000 telephones and stations, and the district unburned about 18,000 stations. The loss of four operating buildings requires a readjustment of the underground cable system to lead to two operating buildings which are left. The underground conduit and cable system was uninjured.

Transfer of the Properties of the National Electric Company.

The plant and other assets of the National Electric Company, Milwaukee, Wis., were formally transferred on May 1 to the National Brake and Electric Company, a corporation of Wisconsin, with a paid-up capital of $1,000,000. This company, as successor to the Christensen Engineering Company, and the National Electric Company, will continue the manufacture of air-brakes and electrical machinery. To facilitate prompt attention to all enquiries, the general sales office of the National Brake and Electric Company has been located at 519 First National Bank Building, Chicago, Ill.

"Banner" Entrance Switch and Plug Cutout.

The Specialty Manufacturing Company, Youngstown, Ohio, has placed on the market several specialties, among which may be noted the "Banner" electric switch and plug cutout. Fig. 1 shows an entrance switch and plug cutout double-pole main.

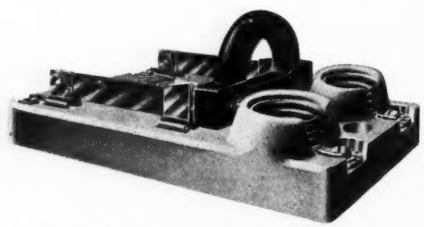


FIG. 1.—MAIN SWITCH AND PLUG CUTOUT.

This is neat in appearance, is compact in form and saves considerable labor in installation. The base is of the best quality of glazed porcelain, the switch is of improved design, nicely finished, and the workmanship throughout is of the best.

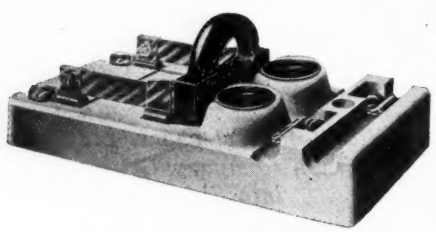


FIG. 2.—BRANCH SWITCH AND PLUG CUTOUT.

The cutout is made for Edison or "D & W" fuse plugs.

Fig. 2 shows the combined switch and plug cutout double-pole branch. This can be used to advantage in many different ways where switch and fuse connections are required. Combinations of these plugs may be used to advantage in the place of panel or tablet boards, and can be so arranged as to take off branches from one or both sides of the mains, as may be required, each branch thus being supplied with switch and fuse connections. The base is of glazed porcelain, the copper and brass parts highly finished and spaced according to approved specifications. The cutout is made for Edison or "D & W" fuse plugs.

Starting Up of an Allis-Chalmers Steam Turbine.

A large steam turbo-alternator built by the Allis-Chalmers Company has recently been started up with great success under more than ordinary circumstances. The turbine referred to is one of 5,500-kilowatt rated capacity, installed in the Kent avenue power-house of the Brooklyn Rapid Transit Company, Brooklyn, N. Y.

The turbine and its direct-connected alternator were ready for operation on February 1, but the boilers, condensing apparatus, piping, etc., were not completed until late in March. While lying idle for nearly two months in an uncompleted station, the insulation of the generator windings naturally became damp, and therefore, as soon as steam was available for running the turbine, it was started up at part speed to dry out the generator.

This drying-out process was going on when, on the morning of March 27 a mishap at another power-house left the railway company short of power. The urgency of the situation was explained to the Allis-Chalmers representatives at about ten o'clock, and they were asked whether they could help out with the afternoon load. Feeling a strong confidence in the apparatus, the Allis-Chalmers engineers decided to put the turbine into regular operation, notwithstanding the fact that it had never been under load, nor had it even been up to speed, except when running unloaded at the West Allis shops.

Additional boilers were therefore fired up and other hurried preparations made for starting. The turbine continued to run slowly until 12 o'clock to dry out the generator. It was then shut down and the engineers proceeded with progressive tests of the insulation, testing up to such a point as they considered safe for the rated voltage of 6,600, but not considering it wise to risk too high a test in view of the damp state of the generator.

The insulation tests were completed at 1.56 P. M., and the turbine was again started up and run up to full speed of 750 revolutions per minute for the first time since installation at the power-house. At 2.20 P. M. the engineers, after carefully assuring themselves that everything was working well, reported that they were ready, and an increasing load was immediately put on until at 3.05 the turbine was carrying a little over 3,000 kilowatts, which was all that the railway company needed at that time.

It is safe to say that such a performance is worthy of record in the history of steam-electric engineering; to carry successfully, in regular operation, a load of nearly 5,000 horse-power within three-quarters of an hour after the machine had been put up to full speed for the first time.

As more load was called for, it was put on, and at 3.45 P. M. the unit was carrying over 4,000 kilowatts. On the following day the load ran up to over 5,000 kilowatts, and on the succeeding day it reached 7,000 kilowatts, the turbine taking heavy loads during the morning and afternoon peaks, and running until late each night.

On March 30 the other apparatus of the transit company being again in working order, an opportunity was given to lay off the turbine and open it up for examination, and here an agreeable surprise awaited the engineers. Heretofore, in the operation of steam turbines, in numerous cases the turbine cylinders have slightly arched upwards under the effect of superheated steam, on account of the top of the cylinder expanding more than the bottom, and in a considerable number of instances this has caused the rotating blades to come in contact with the cylinder and be ripped out.

In the Allis-Chalmers design it was sought to overcome the distortion of the cylinder by such a distribution of the metal as to cause nearly equal expansion of the top and bottom of the cylinder, but at the same time the turbine drum was placed slightly above the centre of the cylinder to assist in preventing contact of the blades in case of distortion. When the turbine was opened up, however, it was found that the compensation for distortion had been slightly overdone, and the cylinder had sagged a small amount and this, together with the high position of the drum, had caused the blading to rub hard for nearly a third of the length of the turbine. With the older types of construction such contact would immediately have made itself manifest by the noise of the rubbing blades, and the blades would have been ripped out before the turbine could be stopped. In the Allis-Chalmers turbine, however, there had, while in operation, been no indica-

tion of the blades rubbing and no damage whatever had been caused; the only sign of contact having taken place was a slight wearing away of the flanges of the channel-shaped shroud ring which protects the tips of the blades in the Allis-Chalmers construction, and which is one of the most valuable patented improvements which that company has introduced.

Besides the blades, which rubbed on account of the slight distortion of the cylinder, a few rows of blades at the inlet end of the turbine were found to have rubbed on sand and other dirt which had gotten into the turbine from the steam pipes, but in this case also the shroud ring prevented all damage.

The only precaution taken before starting up again to help carry the Coney Island load on April 1 was to lower the drum a few thousands of an inch at each end. So far as known this has prevented all further rubbing, and the turbine has been in daily operation ever since, and has not again been opened.

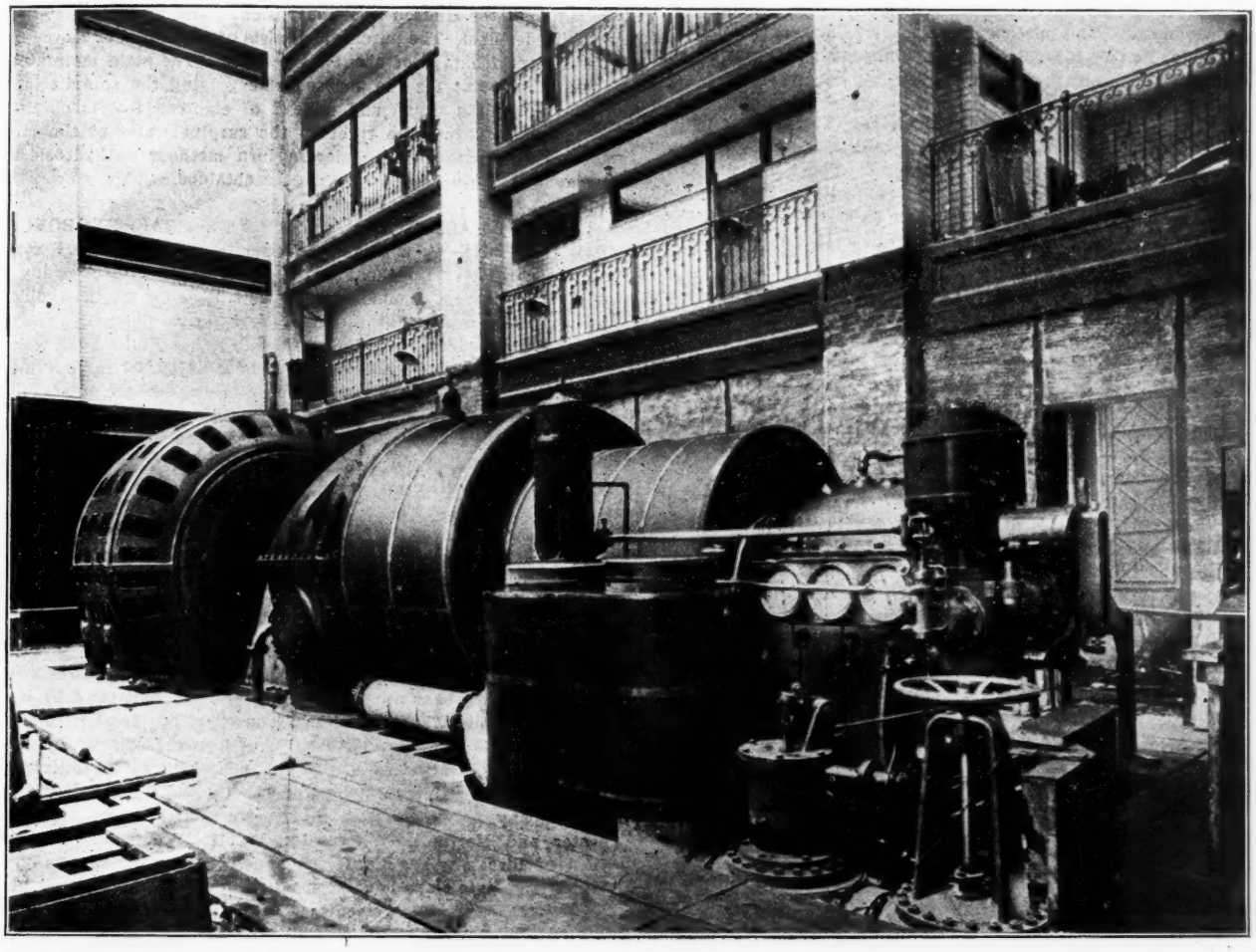
The Allis-Chalmers Company is congratulating itself, not only because it is satisfied that its method of proportioning and constructing its turbine cylinders can be made to overcome the previously experienced difficulties from excessive distortion with superheated steam, but also because the improved blade construction of this company has proven itself in this case to be all that has been claimed for it as regards safety of operation under adverse circumstances.

Not only has the steam end of this outfit realized all the expectations of the builders, but the generator has been equally successful, carrying large overloads each day with the greatest ease. For instance, on April 9, from 5 to 6 P. M., the load averaged about 6,000 kilowatts, and from 6 to 7 P. M., 6,600 kilowatts, while from 6 to 6.30 P. M. it averaged nearly 7,700 kilowatts, with swings up to 9,300 kilowatts. On April 21 for one and one-half hours the load averaged over 8,000 kilowatts, following a run at rated load, with a temperature rise of only twenty-two degrees centigrade.

On April 19 a load averaging 7,500 kilowatts was carried from 5.40 to 6.40 P. M., with swings up to 9,800. One swing of 9,000 kilowatts was carried for forty-five seconds, and one of 9,800 kilowatts for fifteen seconds, this being seventy-eight per cent over rated load.

The highest temperature rise so far met with during any run, notwithstanding heavy overloads, is 25.5 degrees centigrade.

A point about the operation of this turbine which has attracted considerable attention is the perfect balance of the rotating parts, both of turbine and generator, resulting in a minimum of vibration. This perfection of balance, as far as the turbine itself is concerned, is made possible by the system of machine-made blading producing uniformity. The forged drum of the turbine is carefully balanced before blading, but in the various turbines which have been turned out of its shops the Allis-Chalmers Company has not found it necessary to make a single correction of balance after blading, thus testifying to the perfection of its system.



5,500-KILOWATT TURBINE AND GENERATOR IN WILLIAMSBURG STATION OF THE BROOKLYN RAPID TRANSIT COMPANY, BROOKLYN, N. Y.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW FRENCH LINER IN COMMUNICATION WITH BOTH SIDES OF THE ATLANTIC—It is announced that during the recent trip of the new French Line steamship, La Provence, that wireless telegraph communication was had with both Poldhu, Cornwall, and Cape Cod, Mass., at the same time.

OREGON ELECTRIC CONSOLIDATION—By a deal involving $30,000,000, all the light, power and traction companies in the lower Willamette valley, including Portland, using electrical energy, have been consolidated. The purchasers are E. W. Clark & Company, of Philadelphia, Pa.; J. & W. Seligman & Company and Pratt & Company, of New York city.

MERGER OF TELEPHONE COMPANIES—The merger of important Indiana telephone companies controlling a dozen exchanges and 500 miles of line has been agreed upon. The Telephone Company of Indiana is now in process of organization. The company will have a capital stock of $5,000,000 and $5,000,000 in bonds. The independent companies take bonds and stock in payment of the purchase price.

INDIANAPOLIS, NEWCASTLE & TOLEDO ELECTRIC RAILWAY—The Indianapolis, Newcastle & Toledo Railway has made arrangements for the immediate construction of the road. Contracts have been let to the Electrical Installation Company, of Chicago, and the Allis-Chalmers Company, of Milwaukee, Wis. The company will issue $4,500,000 in bonds and $3,500,000 in stock. The officers include D. M. Parry, president; C. S. Hernley, vice-president; W. E. Stevenson, secretary, and Ely Marvin, treasurer.

POWER PLANT TO BE BUILT NEAR WEISER, IDA.—A 20,000-horse-power plant will be built at Eagle Rock, about four miles below the Short Line bridge, between Weiser and Huntington, Ida. A dam will be constructed, work on which will begin as soon as the necessary preliminaries are completed. It is estimated that the dam and plant can be completed at a cost between $60,000 and $75,000. The plant will be located twenty miles from Weiser. The cost of the power will be about $35 per horse-power per year. Power from the plant will also be utilized for irrigation.

MEXICAN LIGHT AND POWER COMPANY TO ENTER PUEBLA FIELD—The Mexican Light and Power Company, whose interests are closely identified with the new Canadian syndicate which has acquired control of the tramways of Mexico City, and has also purchased the street railway at Puebla and the lighting company of that city, will enter Puebla with electric power from Necaxa, and at the same time the power transmission lines of the company will be extended to Pachuca, there to supply power to the mines of Pachuca, Rio del Monte, Zimapan and neighboring districts.

GREAT FALLS (TENN.) POWER PLANT—It is announced that the Great Falls Power Company is to develop a water-power plant on the falls of the Caney Fork river, and that an electric line will be built from Nashville to Chattanooga, Tenn. Mr. C. H. Fisk, of Detroit, Mich., one of the promoters of the scheme, has had a corps of engineers on the ground surveying a line through the mountains in the vicinity of Oate's Island. It is planned to have the proposed electric line connect with the Southern Railway's Stevenson extension at Oate's Island. Passengers and freight hauled over this line would then be distributed to the Southern for all points.

CHARTER GRANTED TO THE OKLAHOMA CITY & SHAWNEE TRACTION COMPANY—A charter has been granted at Guthrie, Okla., to the Oklahoma City & Shawnee Traction Company to build an interurban railway between Oklahoma and Shawnee. The capital stock is given at $1,000,000. The incorporators are: Sherman Collins, Ithaca, N. Y.; Samuel Ketcham and W. H. Crane, Adrian, Mich.; O. P. Workman, D. B. Crane, J. B. Kinne and W. F. Young, Oklahoma City. The estimated cost of the road is placed at $1,200,000. The preliminary survey has been made, and the line will be built in an almost easterly direction between the two cities. The estimated length is forty miles.

POWER FROM THE UPPER HUDSON RIVER—It has been announced that George N. Freeman and others, of Troy, N. Y., have conveyed to Elmer J. West, of Glens Falls, N. Y., the property on the north side of the Hudson river, near Glens Falls, at the point known as the feeder dam. The purchase consists of a hundred or more acres with a river frontage of about three miles. The state maintains a dam at this point for the purpose of supplying the summit levels of the Champlain canal, and a head of eighteen feet is obtained. The purchase covers the right to the surplus water of the river, and it is estimated that, under modern methods of hydroelectric development, 5,000 horse-power can be obtained.

RECEIVER ASKED FOR THE PIKE'S PEAK HYDROELECTRIC COMPANY—A petition has been filed at Colorado Springs, Col., for a receiver for the Pike's Peak Hydroelectric Company by the New York Trust Company, acting as trustee for the bondholders. The complaint avers that the New York Trust Company was appointed trustee under a deed of trust made by the Pike's Peak Hydroelectric Company to secure the payment of $700,000 in first mortgage bonds, $600,000 of which have been issued and are outstanding. One of the terms of the mortgage, according to the complaint, provides that failure to pay the interest when due permits the trustee to declare the full amount of principal and interest. It is alleged that the Hydroelectric company defaulted in the payment of $15,000 interest January 1, 1906, so that the New York Trust Company has declared the principal due, alleging that there is now due and unpaid $615,000.

STRATTON INTERESTS PURCHASE PEEKSKILL (N. Y.) UTILITIES—The Peekskill Lighting and Railroad Company, capitalized at $1,400,000, which furnishes gas and electricity to Peekskill and the adjacent territory, and operates ten miles of electric trolley lines, has been acquired by the interests controlled by F. A. Stratton, of Mount Vernon, N. Y. It is expected that the company will be merged into the Northern Westchester Lighting Company, of which Mr. Stratton is president, and which is capitalized for $2,000,000. The Peekskill company was the last outstanding lighting company in Westchester county not controlled by the Westchester and Northern Westchester Lighting companies. A new board of directors has been elected, with Mr. Stratton as president. Immediate steps have been taken to contract for a new plant and several other improvements. The Peekskill trolley system will be extended to Ossining for a connection with the proposed lines of the Hudson River & Eastern Traction Company.

TWIN CITY TELEPHONE MERGER—The Twin City Telephone Company, of Minneapolis, Minn., has transferred all its property to the Tri-State Telephone and Telegraph Company for $4,000,000. This is an amalgamation of the two companies. The Twin City company is the Minneapolis urban operating company, and the Tri-State company has been its country and long-distance connection. E. H. Moulton, of Minneapolis, is president of both companies and holds controlling interests. The Twin City company had $1,500,000 stock and $1,000,000 bonds outstanding. The Tri-State company is capitalized at $6,000,000. The Twin City stock has paid seventeen quarterly dividends at the rate of seven per cent per annum since organization, and the Tri-State stock bears six per cent. Under the new plan $1,000 in shares of the Twin City company will go into the Tri-State company at a valuation of $1,117.67. The company plans to operate more extensively in Minnesota, North and South Dakota and Iowa, and will extend lines into Wisconsin and finally northwest.

ELECTRIC LIGHTING.

WALLINGFORD, CONN.—The sum of $5,000 has been appropriated for improvements to the electric light plant.

NORWALK, CONN.—The Connecticut Railway and Lighting Company will install new arc lights throughout the city of Norwalk.

GLEASON, TENN.—The Gleason city board has granted the Gleason Water and Lighting Company an exclusive franchise. The company's capital stock has all been subscribed.

LOUISVILLE, KY.—The Louisville Lighting Company has filed amended articles of incorporation permitting the company to operate a steam heating plant and electrical apparatus.

ATLAS, MICH.—Promoters are preparing to build an electric power plant at Atlas to furnish light and power for the city of Flint and other nearby towns at figures cheaper than now in force.

ALBANY, N. Y.—The common council has granted a franchise for five years to the Hudson River Electric Power Company to erect poles and string wires in Cohoes for furnishing electric power to manufacturers.

JOLIET, ILL.—The Joliet city council has granted a fifty-year franchise to the Channahon Light and Power Company. The company agrees to pay, during the life of its franchise, $45,000 in cash in annual installments.

NEW BRAUNFELS, TEX.—The Landa Electric Light and Power Company is making extensive improvements to its power plant by the addition of three large dynamos and a switchboard of seven panels, of blue Vermont marble.

MACON, GA.—It is stated that Atlanta capitalists are now working under an agreement with Macon men of financial strength to erect a large electric power-plant in Macon to be ready for operation in the early spring of next year.

NEWARK, N. Y.—The New Light, Heat and Power Company is making arrangements to furnish light for the village of Phelps. The local plant will be enlarged to meet the additional demand, and the service will be a twenty-four-hour one.

WILMINGTON, DEL.—Ground has been broken for the proposed electric plant of the Wilmington Light, Power and Telephone Company, on the site purchased on the north side of the Brandywine. It is expected that the plant will be finished some time next fall.

CORYDON, IND.—The Corydon board of trustees has contracted with W. H. Keller for a new lighting system, the city to be lighted until midnight with 100 lamps of sixteen candle-power at fifty cents per light per month, the previous cost being fifty-seven cents per light.

HEMET, CAL.—The electric light plant is in course of rebuilding. A new engine room, fifty by twenty feet, with concrete floor, has been completed, a new boiler has been installed, and a marble switchboard has been put in. The system of lighting has been changed from direct to alternating.

BUFFALO, N. Y.—At a recent meeting the following nine men were elected directors of the Buffalo General Electric Company, to serve for one year: Daniel O'Day, George Urban, Jr., William C. Warren, Henry W. Burt, Walter P. Cooke, Robert W. Pomeroy, Andrew Langdon, Peter P. Miller and Charles R. Huntley.

ELK RAPIDS, MICH.—The Elk Rapids council has granted a franchise for an electric lighting plant to A. B. Dougherty. The one granted last year expired April 21. The franchise is similar to the former one except that it calls for all-night service and the other called for moonlight. The plant is to be in operation within six months.

ATLANTA, GA.—The North Georgia Electric Company has secured franchises for the distribution of electric power throughout the city of Atlanta in competition with the Georgia Railway and Electric Company. Its power is transmitted from Gainesville, about ninety miles distant. The company will put up a building at Atlanta to cost $15,000.

LACONIA, N. H.—The Laconia Electric Light Company is to make extensive improvements to its power-station situated at the Lakeport end of the city within the next few months. The power-house is to be enlarged so that it will accommodate three Deisel engines of 250 horse-power each. Other important changes will be made at the station.

NEW YORK, N. Y.—Mayor McClellan has authorized Water Commissioner Ellison to sign contracts with the various lighting companies which submitted bids early in February at the maximum rate allowed by last year's laws. Under these terms the annual amount paid for public lighting will be $780,000 less than the amount called for in the Oakley contracts of 1904.

CRESTED BUTTE, COLO.—The suit between the town of Crested Butte and the light and water company has been settled by the town agreeing to purchase the light and water plant, which is owned by C. W. Badgley, of Denver, for $20,000. The town board has promised to reduce present prices of light and water twenty per cent.

PITTSTON, PA.—Six capitalists, three of whom are residents of Duryea, are making preparations to install an electric light plant in that town, to furnish light for commercial purposes. The municipal lighting is now being done by the Citizens' Electric Illuminating Company, of Pittston, whose contract does not expire for several years.

MARQUETTE, MICH.—Ontonagon village has awarded a contract to the Lane & Bodley Company, of Cincinnati, Ohio, for a new electric lighting plant. The equipment will consist of a 140-kilowatt dynamo, 225-horse-power Corliss engine, switchboard and sixteen arc lamps. The price is $8,165, which includes the cost of installation, and the plant is to be in running order in forty days.

ERIE, PA.—A reorganization of the Erie Electric Company, which has been absorbed by an Eastern syndicate, has been effected by the election of J. B Mayer, of Buffalo, president; H. F. Wilbor, Erie, vice-president and general manager; C. H. Werner, New York, secretary; L. I. Pollitt, Baltimore, treasurer. A large amount of money will be expended in improving the service.

EUREKA SPRINGS, ARK.—Matthews & Barnes, who recently obtained an electric power franchise for ninety-nine years from Eureka Springs, have purchased the Woodruff power site on King's river, nine miles east of the town, and will install large turbine water-wheels transmitting the power to the proposed plants at Eureka Springs. Sufficient power can be generated to supply every industry, public and private, in the city.

ST. CHARLES, MO.—The city electric light power-house boilers and other machinery at the St. Charles power plant collapsed recently, and the city is in darkness. City Electrician Pierson states that it will be impossible to repair the old machinery further, and that new machinery must be purchased, which will cost at least $15,000. The city council is debating the question of consolidating the city waterworks and electric light plant.

PLACERVILLE, CAL.—There have been filed in the office of the county recorder two notices of appropriation of water—one for 6,000 inches, flowing in the south fork of the American river, and another for 3,000 inches flowing in Silver Fork. The water is to be conveyed by flumes and ditches to a point at or near the intersection of the South Fork of the American with Silver Fork, where a power-plant is to be established, the power to be used for mining, manufacturing and electrical purposes.

PHILADELPHIA, PA.—The Philadelphia Electric Company, which recently purchased the old Assembly building at the southwest corner of Tenth and Chestnut streets, with a view to remodeling the structure for its offices, has abandoned that idea, and instead will demolish the present property and erect on the site a handsome seven-story fire-proof office building, covering the entire lot, which has a frontage of 31 feet and a depth of 230 feet to Sansom street. Architect James H. Windrim has been commissioned to prepare the plans for the new structure, which will cost about $500,000.

VALPARAISO, IND.—A reorganization of the Evansville Electric Company has been effected, whereby Henry W. Marshall, Charles Murdock and Samuel T. Murdock, of Lafayette, secure a controlling interest in the company. Charles Murdock was elected president to succeed James O. Parker, and Henry Marshall was elected secretary and treasurer to succeed Judge Alexander Gilchrist. Herbert

Moran retained his position as vice-president and general manager. Thomas Krutz, of New York, and William G. Krutz, of Chicago, are directors in the company with the four other officers mentioned.

PHILADELPHIA, PA.—The Philadelphia Suburban Heat, Light and Power Company, which was organized a short time ago by State Treasurer William L. Mathues, H. J. Makiver and several Philadelphia capitalists, and purchased the plant of the Lansdowne Electric Light Company, at Lansdowne, has also purchased the plant of the Farraday Company, at Morton. This plant and the one at Lansdowne will be abandoned after the main plant at Darby has been completed. It is understood that the company will extend its system throughout Delaware county and all lines will be supplied with light and power from the main station at Darby.

SOMERSET, PA.—The Quemahoning Electric Power Company has been organized by Jonathan E. Giffen, of Stoyestown; C. W. Weigle, of Hooversville; J. L. Barchus, of Salisbury, and D. S. Martin, of Pittsburg. It is the purpose of the promoters to install a large electric power plant in the vicinity of Hooversville to furnish electrical energy for lighting, heating and power purposes to the towns of Hooversville, Stoyestown, Sprucetown, Jenners, Holsopple, Davidsville, Foustwell, and the new mining town of Jerome. For this purpose a large power-plant will be built at the mouth of a coal mine in Quemahoning township, where a supply of cheap fuel will always be available.

SPOKANE, WASH.—The Spokane Power Development Company has been organized. The capital stock of the company is $500,000 and it will construct and operate power plants in Washington, Idaho, Oregon and British Columbia. Jay P. Graves, who is practically the head of the company, states that the water powers, lands and privileges recently purchased by him at Kettle Falls will be transferred to the new company; also the "Bowl and Pitcher" water power, the power at Nine Mile bridge and the franchise, recently purchased by Mr. Graves, for an electric light and power plant in Spokane. Besides Mr. Graves, the trustees of the new corporation are F. A. Blackwell, F. Lewis Clark, Hiram B. Ferris and W. G. Davidson.

YREKA, CAL.—An agreement has been entered into between the Siskiyou Electric Power Company and the Dewey Mine for the extension of the electric line from Montague, its present southern terminus, in Shasta Valley, to the town of Dunsmuir, near the Shasta county boundary line, a distance of fifty-two miles. The line will pass through and deliver power and light to Gazelle, Edgewood, Weed, Upton, Sisson, Mott, Shasta Springs, Shasta Retreat, Upper Soda Springs and Dunsmuir. At Upton a branch line will be run to McCloud, eighteen miles distant, making in all seventy miles of new line. The estimated cost of the work is $75,000, and the agreement calls for a ten-year lease, with the option of a renewal at the end of that time for another ten years. Last summer the two electric corporations in Siskiyou county were consolidated, and the new company has $500,000 invested in its two plants and the pole lines. It has ninety miles of wires, and the extension to be made by the sub-company will increase the lines over which electricity is sent to 160 miles, all in Siskiyou county.

NEW PUBLICATIONS.

THE CLARKSON BULLETIN—The April number of the Clarkson Bulletin, published by the Thomas S. Clarkson School of Technology, Potsdam, N. Y., contains a description of the commemorative exercises held on February 22 last. The charter day exercises and the decennial anniversary, held on March 19, are also described. The calendar for the 1906-1907 session and complete information concerning the courses of instruction are included.

BULLETIN OF SYRACUSE UNIVERSITY—The April number of the Syracuse University Bulletin contains 344 pages and is replete with interesting information concerning the courses of study at the university. The College of Liberal Arts has 1,247 students; the College of Fine Arts, 814 students; the College of Medicine, 155 students; the College of Law, 167 students; the College of Applied Science, 400 students, and eighty-eight students have been enrolled for the summer school.

TELEPHONE AND TELEGRAPH.

CALDWELL, UTAH—The Bell Telephone Company has opened a new line to Dixie.

SPOKANE, WASH.—A franchise has been granted by the county commissioners to the Lakeview Telephone Company.

ERIN, TENN.—The Clarksville Home Telephone Company is rebuilding the telephone line from Clarksville to Memphis.

PRICE, UTAH—The Eastern Utah Telephone Company has acquired the Price and Fort Duchesne military telegraph line as an adjunct to its system.

NORTH TONAWANDA, N. Y.—The work of building a new exchange to cost $6,000 has been started by the Home Telephone Company at North Tonawanda.

OKLAHOMA, OKLA.—The Pioneer Telephone Company has purchased the exchange at Pawhuska, the line from Webber Falls to Porum, I. T., also the line from Sallisaw to Borrou Farks, I. T.

UTICA, N. Y.—The Bell Telephone Company has let contracts in Syracuse involving the expenditure of something like $200,000, for the construction of about twenty miles of subways in that city.

FARGO, N. D.—Commercial and other telegraphic business between Fargo and Chicago has grown to such dimensions that an improved service has been found necessary by the Western Union Telegraph Company.

NEWKIRK, OKLA.—The Newkirk Commercial Mutual Telephone Company has completed its organization and ordered $1,500 worth of materials shipped at once. The new telephone system will be in operation within sixty days.

CENTREVILLE STATION, N. Y.—The Neversink River Telephone Company has been organized. The directors are: L. V. Gardner, Ernest Kinney, Zadoc Wintor and Ellsworth Baker; Dr. Laidlow and Frank Laidlow, of Hurleyville, and H. Curtis, of Albany.

ROME, IOWA—A company has been organized and two new telephone lines will be put in this spring. One will extend north and one south of town. Work will be commenced on them at once. These lines will make connections with the Farmers' line, which goes to Glasgow, Lockridge and other nearby cities.

WASHINGTON, D. C.—The Chesapeake & Potomac Telephone Company has let the contract for the erection of its new eastern exchange. The building will cost $100,000, and will be located at 629 B street Northeast. It will have an equipment costing more than $300,000, making a total investment of $400,000 to $500,000.

ATLANTA, GA.—The Bell Telephone Company has planned to spend $50,000 in extending its system in Augusta. The number of telephone stations connected with the Augusta exchange at the present time is 2,411. The increase for the year ending December 31, 1905, was twenty-six per cent, and the indications are that it will be much larger during the present year.

TOPEKA, KAN.—At a special session of the state charter board a charter was granted to the Topeka Independent Telephone Company, the new concern which succeeds to the old Independent Telephone Company, of Topeka. The stockholders in the new concern are the same as the old, the only difference being that the new company has $1,000,000 capital, and the old one only $150,000. The incorporators of the new concern are: B. F. Pankey, F. W. Pankey, L. M. Pankey, E. A. Pankey and D. L. Pankey. The increase in the capital is for the purpose of largely improving the facilities of the plant.

ENGINEERING SOCIETIES.

AMERICAN SOCIETY OF MODEL ENGINEERS—The American Society of Model Engineers held its second meeting at the Berkeley Lyceum, New York city, on Wednesday evening, May 2. A half-hour talk on "Shop Work with Lathe and Shop Tools" was given by Mr. Barclay, followed by a discussion on various subjects, including the slide valve. An explanation of the functions of the locomotive slide valve and the link motion was given by Mr. Stoye. Members were requested to bring samples of their work for exhibition at the next meeting. The secretary is Mr. W. E. Spon, 123 Liberty street, New York city.

PERSONAL MENTION.

MR. OREN ROOT, JR., has been elected first vice-president of the Metropolitan Street Railway Company, New York city.

MR. CHARLES L. EDGAR, president of the Edison Electric Illuminating Company, Boston, Mass., will sail for Europe on May 22.

MR. LOUIS A. FERGUSON, second vice-president of the Chicago Edison Company, and Mr. R. C. P. Holmes, purchasing agent, Chicago Edison Company, sailed on the Baltic this week for a trip to Europe.

MR. JOHN W. LIEB and wife sailed last week on a three-months' trip to Europe. Mr. Lieb has not taken many holidays from his progressive work as general manager of the New York Edison Company, and his friends will extend wishes for a very pleasant trip.

MR. GRAHAM SMITH, formerly in charge of the Westinghouse Companies' exposition and convention publicity as the New York Westinghouse press representative, and recently engaged in advertising work under his own name, sailed this week for a journalistic tour of several months abroad. On his return he will assume the direction of the eastern advertising interests of several prominent corporations of the West and Middle West, with an office in the Flat Iron Building, New York city. He will make a specialty of the preparation of high-class industrial books. Mr. Smith was born on August 24, 1878, in Buffalo, N. Y., and graduated from Harvard College with high honors in English in 1900. After a year's travel he spent three years on the staff of the *Evening Sun* as news reporter, assistant city editor, real estate editor and writer on financial topics. During his connection with the Westinghouse Companies Mr. Smith prepared some very handsome pieces of literature, which have received wide distribution throughout the electrical and allied fields.

OBITUARY NOTICE.

MR. CHARLES L. SPIER, a prominent young business man, representing large electrical interests on Staten Island, was shot and killed, it is supposed, by a burglar at his home, Staten Island, N. Y., on the morning of Monday, May 7. Mr. Spier was only thirty-eight years old, but had achieved extraordinary success and was marked as one of the most promising of the younger captains of industry. At one time a newspaper man, he later became an expert engineer. He was president of the Staten Island Midland Railroad Company, Sea Coast Traction Company, New York Improvement and Investment Company and Yetman Transmitting Typewriter Company; vice-president of the New Jersey & Staten Island Ferry Company and West End & Long Branch Railway Company; secretary and treasurer of the Richmond Light and Railroad Company, Richmond Borough Company, Asbury Park & Sea Girt Railroad Company and Seashore Electric Railway Company; director of the Southfield Beach Railroad Company, Rapid Transit Ferry Company and Richmond County Power Company. He was a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, New York Railroad Club and Staten Island Chamber of Commerce.

ELECTRICAL SECURITIES.

The past week was memorable in many ways, particularly with regard to the financial changes. The downward course of prices that has been in progress since the San Francisco disaster was continued, and on a larger scale. Almost the entire active list made new low prices for the year, the extreme declines varying from five to fifty points. The latter part of the week, however, saw a recovery and smart rallying in many instances. The total transactions in the middle of the week resulted in an excess of 2,000,000 shares. It is expected that liquidation is ended, with the wiping out of weakly margined and small bull speculators. Importance is attached to an indication of public buying. One of the weakest factors in the recent market position was the absence of the general public. It is held, however, that the quick recovery and the general improvement in business will bring the public into the market and so influence conditions that the upward rally will be continued. The fears of a coal strike, which have been an adverse factor, will, it is expected, be removed at once. It has been announced that the miners have decided to accept the operators' terms of a renewal of the previous agreement, or a three-year contract on the basis of the award of the 1902 strike commission. This means that the coal strike will be formally declared off, and there will be an early resumption of work. This is held to be a strong bull factor in the outlook for the market's future. There has been no let-up in the prosperity of the railroads. This has been reflected in increasing earnings, notably those of the Pennsylvania Railroad for March. The April business failures, with small liabilities, also point to the stability of commerce in general.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MAY 5.

New York:	*Closing.*
Allis-Chalmers common	21
Allis-Chalmers preferred	55⅞
Brooklyn Rapid Transit	78
Consolidated Gas	137
General Electric	166½
Interborough Rapid Transit	217½
Kings County Electric	162
Mackay Companies (Postal Telegraph and Cables) common	63¼
Mackay Companies (Postal Telegraph and Cables) preferred	71½
Manhattan Elevated	152
Metropolitan Street Railway	112½
New York & New Jersey Telephone	142½
Western Union	91½
Westinghouse Manufacturing Company	158

Boston:	*Closing.*
American Telephone and Telegraph	134
Edison Electric Illuminating	245
Massachusetts Electric	63½
New England Telephone	137
Western Telephone and Telegraph preferred	89

The report of President Thomas Sherwin, of the New England Telephone and Telegraph Company, states that the number of stations added during the year was 33,804, making the total on December 31 166,563. Other stations operated under the management of the company brought the number up to 185,448, as compared with 148,199 at the end of 1904. The report also says that more than 62 per cent of the wire used for exchange service is underground and 76 per cent of the entire mileage of the exchange wire is in underground and aerial cable. The charge for maintenance continues to be the largest item of expenses, the amount for the last year as shown by the treasurer's report being somewhat more than one-third of the gross revenue. The expenditure for new construction during the year amounted to $1,941,895. In addition, the expenditure for land and buildings was $436,908. The underground system of the company now consists of 2,664,831 feet, about 505 miles of conduit, containing 13,158,997 feet, or 2,492 miles of duct; 5,907,105 feet of cable have been drawn into the underground system.

At the annual meeting of the New England Telephone and Telegraph Company Francis H. Dewey and John F. Hill were elected directors. The former succeeded Stephen Salisbury, deceased, while the latter succeeded Thomas B. Bayley, who last year temporarily succeeded Benjamin C. Dean, also deceased. At a special meeting of the stockholders of the New England Telephone and Telegraph Company it was voted to increase the capital stock from $30,000,000 to $50,000,000.

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8
Philadelphia Rapid Transit	27
United Gas Improvement	95

The Philadelphia Electric Company's directors have declared the regular semi-annual dividend of 2½ per cent, payable June 15 to stockholders of record May 22.

Chicago:	*Closing.*
Chicago Telephone	106
Chicago Edison Light	142
Metropolitan Elevated preferred	66
National Carbon common	80
National Carbon preferred	119
Union Traction common	5
Union Traction preferred	16

Northwestern Elevated April average was 84,244 passengers daily, an increase of 4,465.

The average number of passengers carried daily on the South Side Elevated for April was 95,756, an increase of 3,855.

The average number of passengers carried daily on the Metropolitan Elevated in the same month was 137,477, an increase of 12,481.

ELECTRIC RAILWAYS.

NEW HAVEN, CT.—The Consolidated Railway Company is to extend its line from Branford to Stony Creek.

MISSOURI VALLEY, IOWA—Papers have been signed for the transfer of the Missouri Valley electric light, heating plant and telephone systems to the Cedar Rapids Gas and Electric Light Company.

SPOKANE, WASH.—Charles P. Lund, acting for Spokane people, has asked the city of Cheney for a franchise for an electric road through that place. The road contemplated would be from Spokane.

MARSHALLTOWN, IOWA—Hamilton Browne, of Chicago, has made a proposition to the people of Marshalltown and Tama to build an interurban between those cities and Toledo to parallel the Northwestern line.

SYRACUSE, N. Y.—The contracts for the erection of the four new electric substations along the West Shore between Utica and Syracuse have been awarded to the John F. Hughes Construction Company, of Utica.

LOS ANGELES, CAL.—A company has been organized to build a traction line from Tucson to a resort in the Catalina mountains, fourteen miles distant. It will connect with the electric street railroad, which is now building.

NEW YORK, N. Y.—The New York Edison Company will erect a new power station at 155 and 157 East Sixtieth street, New York city, on a plot forty by 100. The estimated cost of the structure is $75,000. Work will be begun on June 1.

SPOKANE, WASH.—W. H. Plummer, president of the Spokane & Big Bend Railway Company, announces that the line to Davenport will be in operation by January 1, 1907; also that there will be some changes in the road north of that city.

JACKSON, TENN.—A Louisville syndicate, L. W. Botts and associates, has bought the Jackson street railway and electric light plant for $115,500. The new owners will develop and extend the system, and expect to invest $250,000 for this purpose.

SPRINGFIELD, ILL.—The Centralia & Central City Street Railway Company and the Centralia & Central City Traction Company, both of Centralia, have consolidated under the name of the Centralia & Central City Traction Company, with $110,000 capital stock.

LEESBURG, VA.—An electric railway from Vienna to Herndon on the south side of the Bluemont division of the Southern Railway is a possibility. A survey has been ordered. The line will be an extension of the Washington-Arlington & Falls Church road.

BARBERTON, OHIO—Grading has been begun west of Barberton by a force of 100 men preparatory to building the new street car line to Wadsworth by the Northern Ohio Traction and Light Company. This line will connect with the Akron-Barberton line at the west end.

GREENWOOD, S. C.—The commissioners of public works of Greenwood have executed a contract with the Savannah River Power Company to furnish the town of Greenwood with electric power for a period of ten years, with an option of ten years more at the same price.

NEW HAVEN, CT.—C. W. Blakeslee & Sons, of New Haven, have been awarded a $500,000 contract in connection with the building of the trolley road from Naugatuck to Seymour. Last February the company was given the contract to build the line from Naugatuck to Beacon Falls.

WASHINGTON, D. C.—Formal permission has been granted by the district commissioners to the Capital Traction Company to open the streets for the construction of an underground trolley system, in extending its line from Park road northward on Fourteenth street Northwest.

JOLIET, ILL.—The Joliet city council has granted to the Joliet & Southern Traction Company a fifty-year franchise. In return, in the way of concessions, the company agrees to build two modern bridges, one at Ruby street and the other at McDonough, and to give $5,000 to park purposes.

AUGUSTA, ME.—Articles of association of the Mattawamkeag & Northern Railroad have been filed. The proposed road will extend from Mattawamkeag to Millinocket, a distance of twenty-two miles, to connect the latter town with the Maine Central and Canadian Pacific railroads at Mattawamkeag. The capital is $100,000.

PHILADELPHIA, PA.—Mayor Weaver has approved the plans for the construction of the Philadelphia Rapid Transit Company's Market street subway east of the city hall. The building of the underground electric road will be pushed, and the company hopes to have it in operation within two years.

WILMINGTON, DEL.—General Manager Hoff, of the Wilmington City Railway Company, has taken out a permit for an addition to the power-house of the company, on the north side of the Brandywine, at a cost of $18,000. The ground has been cleared and the work of building is to be started at once.

SPRINGFIELD, ILL.—The secretary of state has issued a license to incorporate to the Salem, Springfield & Peoria Railroad Company. The line to be constructed is from a point on the Chicago & Eastern Illinois Railroad near Salem, Ill., through the counties of Marion, Fayette, Montgomery, Christian, Sangamon, Menard, Logan, Tazewell, to Peoria.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company has closed a contract with the Westinghouse Machine Company for a large amount of electrical machinery for its Philadelphia power-house, including five 2,500-horse-power rotary converters and necessary switchboard appliances, amounting to several hundred thousand dollars.

LINTON, IND.—At a meeting of the Linton city council, the Linton electric light plant was sold to the local gas company for $32,000, the company to give the present building and grounds to the city. The company agrees to furnish street lights at $50 a year, all-night service. The company will pay $20,000 cash and $1,000 yearly for twelve years.

CANTON, ILL.—Stock to the amount of $65,000 has been subscribed in Canton and Fulton counties toward the construction of the Illinois Central Electric Railway, an interurban road to connect Canton with Lewistown and other smaller towns in the county. A Cleveland syndicate will take the remaining $235,000 worth of stock and finance the enterprise.

SPOKANE, WASH.—C. H. Weeks, Cyrus Bradley and Benjamin J. Weeks, of Spokane, and W. W. Cannon, of Centralia, Wash., have acquired all the property franchises and rights of the Centralia-Chehalis Electric Railway and Power Company, and will immediately build a line connecting those two cities, which ultimately will be extended to Tacoma and Portland.

CALDWELL, IDA.—Interest in the San Francisco, Idaho & Montana Railroad has been revived by the filing in the land office at Boise of a plat of its route through the state. W. E. Pierce announces that the Caldwell-Boise electric road has been financed. Material has been ordered, and the work of construction has begun. The cost of the line is estimated at $700,000.

MILWAUKEE, WIS.—Work is being rushed on the right of way of the Chicago & Milwaukee Electric Railway Company between Kenosha and Milwaukee. There will be a private right of way 100 feet wide the whole distance. President A. C. Frost says that the line will be an air line about thirty miles in length, built considerably to the west of the Chicago & Northwestern road.

DOVER, DEL.—A charter has been issued to the Wilmington & Edge Moor Railway Company, with a capital stock of $200,000. The incorporators are David Ott, assistant superintendent of the Wilmington City Electric Company, and others interested in the Interstate Railways Company, which controls the Wilmington City Railway Company. The company wants to build a system of railways in the new section of the ninth ward, Wilmington, including Todd's Cut and Edge Moor.

BUFFALO, N. Y.—The International Railway Company has begun work upon the construction of its new line in Fillmore avenue. The work will be rushed to completion, and it is expected that the line will be in operation by September 1. The company is also to build a new car house on the east side. It will accommodate 135

cars, and the estimated cost of the building is $150,000. A new substation is also to be built at a cost of $100,000.

TORONTO, OHIO—Van Horn Ely, president of the East Liverpool Traction and Light Company, has completed the task of obtaining a right of way for a double-track extension of the road from Wellsville and York Creek Junction through Toronto, where a connection is to be made with the Steubenville & Ohio Valley Railway Company. This right of way completes the preliminary work for through electric service from Smiths Ferry, Pa., to Wheeling, W. Va.

PITTSFIELD, MASS.—The Pittsfield Electric Company will spend $50,000 this summer on a new power station at Silver lake on the tract recently purchased by the company. Plans are being drawn for the power-house and boiler house and work will be commenced as soon as possible. At a meeting of the directors of the company it was decided to have the plant in operation if possible by the first of September. The power-house is to be eighty by one hundred feet.

YOUNGSTOWN, OHIO—At a meeting in Ashtabula of those interested in the recently purchased Pennsylvania & Ohio electric railway, the following directors were elected: L. A. Robison, J. B. Yohe, W. B. Morris, Samuel Moody, of Pittsburg; W. S. McKinnon, L. Hills, B. W. Baldwin, A. F. Galpin, Frank Fortune, of Ashtabula. Officers were chosen as follows: L. A. Robison, of Pittsburg, president; W. B. Morris, of Pittsburg, secretary; B. B. Seymour, of Ashtabula, treasurer.

DENVER, COL.—Articles of incorporation of the Denver Northern Railway Company, the proposed electric line from Denver through northern Colorado to the state line, have been filed with the secretary of state. The enterprise, capitalized for $3,000,000, is said to be backed by W. C. Brown, of Chicago, and several of his friends. Robert Law, of Denver, is named as the president of the company, and Charles P. Brown, of Ottumwa, Iowa, will be the secretary and treasurer. W. C. Brown, Charles W. Waterman and Morris J. Jones, of Boulder, with the officers named, comprise the directorate for the first year.

OGDEN, UTAH—A $200,000 railroad corporation has been organized in Ogden. The company is to be known as the Utah & Idaho Railroad Company. The purpose of the corporation will be the owning and operating of railroads in the state of Utah and especially between the cities of Provo and Logan. The company is incorporated for a period of 100 years, with Ogden as its principal place of business. According to the articles it is estimated that the cost of constructing the line between Logan and Provo, a distance of approximately 150 miles, will be $12,000 per mile. The capital stock of the company is fixed at $200,000, divided into shares of the par value of $100 each. The officers elected for the ensuing year are David Eccles, president; Mathew S. Browning, vice-president; Charles H. Kircher, secretary; H. H. Spencer, treasurer, and they with H. H. Rolapp, Nels C. Flygare and R. S. Joyce form the board of directors. It is the intention of the company to immediately set to work to secure a right of way between Provo and Logan and to build an electric interurban car line between these two cities.

NEW MANUFACTURING COMPANIES.

LITCHFIELD, CONN.—The Litchfield Electrical Supply Company, of Litchfield, has been incorporated with a capital stock of $25,000.

BALTIMORE, MD.—The G. E. Watts Electrical Construction Company, with a capital stock of $1,000, has been incorporated by Samuel M. Sachs, J. J. McNulty, D. Gray Elderkin, W. N. Hechheimer and Harry Hechheimer.

MARION, IND.—The Marion Electric Company, with a capital stock of $10,000, has been reorganized and incorporated and the officers of the new company are as follows: P. L. Nussbaum, president; E. C. Bacon, vice-president; Simon Koontz, Jr., secretary, and J. N. Barnard, treasurer. The company will deal in electrical supplies.

NEW INCORPORATIONS.

LINCOLN, NEB.—Sargent Independent Telephone Company. $1,000.

COLUMBUS, OHIO—Stillwater Mutual Telephone Company, Flushing. $1,000.

HELENA, MONT.—The Belt Valley Telephone Company. $25,000. Incorporators: C. E. K. Vidal, J. K. Castner and A. P. McAnelly, all of Belt.

GUTHRIE, OKLA.—The Mangum Telephone Company. $100,000. Directors: A. Gordon, of Excelsior Springs, Mo.; D. D. Taylor and D. H. Wright, of Mangum.

ST. PAUL, MINN.—Hastings Electric Light and Power Company, Hastings. $50,000. Incorporators: J. Roshelt, Nels Enge and William Robertson, Minneapolis.

MADISON, WIS.—Cream City Telephone and Telegraph Company, New York. A statement and articles to operate in Wisconsin. The Wisconsin interests are $10,000.

ST. PAUL, MINN.—New Richland Telephone Company, New Richland. $20,000. Incorporators: M. A. Hodgkins, H. E. Johnson, P. O. Sunde and others, New Richland.

MADISON, WIS.—The Eastern Fond du Lac County Telephone Company, Dotyville. $5,000. Incorporators: J. M. Stack, Thomas Timblin, G. Rohlfs and A. J. Morse.

ALBANY, N. Y.—Butler Independent Rural Telephone Company. $1,000. Incorporators: John B. Atkins, Butler, N. Y.; S. H. Viele and L. I. Douglass, South Butler, N. Y.

MILLSTADT, ILL.—St. Clair Farmers' Mutual Telephone Company. $2,090. To operate a telephone system. Incorporators: Richard Boher, Daniel A. Haas and Conrad Keck.

ST. PAUL, MINN.—Current Lake Co-Operative Telephone Company, Balaton. $10,000. Incorporators: August Swanson, I. Wolf, Andrew Ryberg, T. M. Helseth, Albert Folstad, H. Hjermstad, Olof M. Olson and P. A. Pederson.

AUGUSTA, ME.—Maine & New Hampshire Railroad Company. To build an electric road between Standish and Hollis on the west side of the Saco river. $1,000. George B. James, of Boston, president; A. C. Kennett, Conway, N. H., treasurer.

GUTHRIE, OKLA.—The Davis & Turner Falls Railway Company, of Oklahoma City and Davis. $50,000. Directors: R. W. Wilburn, A. L. Welsh, J. W. Giant, Robert Chowing and W. L. Demery, of Oklahoma City, and John Watts, of Newton, Kan.

MADISON, WIS.—The Union Grove & Parit Telephone Company, Union Grove. An amendment changing its name to the Union Grove Telephone Company, and increasing its capital from $2,000 to $5,000. John S. Blakey, president, and William J. Callander, secretary.

AUGUSTA, ME.—The Continental Public Utilities Company. To construct, buy and operate gas and electric lighting plants and street and interurban railroads. $12,500,000, of which $10,000,000 is common stock. Milard W. Baldwin, of Portland, president and secretary.

ALBANY, N. Y.—Lake Valley Telephone Company, Clarksville, Albany county. To operate in towns of New Scotland and Coeymans. $300. Directors: W. H. Van Natten, E. L. Mitchell, Arthur Osterhout, John Swart, New Scotland; A. C. Mosher, Fred Haines, Lester Robinson, Coeymans.

LITTLE ROCK, ARK.—Hot Springs, Ouachita & Mena Railroad Company. $1,000,000. Incorporators: James F. Read and J. B. McDonough, of Fort Smith; J. B. Wood, of Hot Springs, and Gilson Wott, of Mount Ida. To build a road from Hot Springs through Montgomery county to Mena, a distance of fifty miles.

BALTIMORE, MD.—Lorraine Electric Railway Company. To construct a passenger railway not exceeding twelve miles, and for maintaining lines of stages for the conveyance of passengers and mails at a point near or on the line of the United Railways and Electric Company near Dickeyville. $25,000. Incorporators: William C. Page, Leonidas G. Turner, Dr. George Y. Everhart, William E. Zimmerman and C. Frank Emmart.

INDUSTRIAL ITEMS.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., is again calling attention to its double-pole sockets with an illustrated advertising card.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland, Ohio, will be pleased to send its new bulletin descriptive of locomotive cranes, buckets and tubs.

THE HOLOPHANE GLASS COMPANY, 227 Fulton street, New York city, is distributing a blotter bearing an illustration of the new "Pagoda" reflecting arc.

THE WESTINGHOUSE TRACTION BRAKE COMPANY, Pittsburg, Pa., will be pleased to send instruction pamphlet T-5042, dealing with electric pump governor type J.

THE HOWARD CHEMICAL COMPANY, 63 Fulton street, New York city, has published an interesting booklet concerning the application of "Scale-Off" boiler compound.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., announces the opening of a branch office in Pittsburg. This office will be located in the Frick Building annex.

THE NATIONAL X-RAY REFLECTOR, 124 Franklin street, Chicago, Ill., has prepared some new literature concerning the X-Ray "Poke Bonnet" reflector. This material the company will be pleased to send upon request.

THE ECK DYNAMO AND MOTOR WORKS, Belleville, N. J., has very largely increased its plant. The product of this company is meeting with a constantly increasing demand, and the company will have better facilities for increasing the output.

THE METROPOLITAN ENGINEERING COMPANY, Brooklyn, N. Y., has ready for distribution electric sign catalogue No. 101. This catalogue will be sent upon request. The company announces its removal to its new factory building, 1250 Atlantic avenue, Brooklyn.

M. W. DUNTON & COMPANY, Providence, R. I., manufacturers of "Nokorode" soldering paste, have established agencies for the sale of "Nokorode" in almost every state in the Union, as well as many foreign agencies. The company announces constantly increasing demands for this material.

THE PHOSPHOR-BRONZE SMELTING COMPANY, Philadelphia, Pa., has ready for distribution price list No. 23. This gives the revised prices on "Elephant Brand" phosphor-bronze spring sheet, hard rolled sheet and plates, slitting metal, wire, telephone and telegraph wire, circles, wire ropes, castings, ingots and anti-friction metal. The price list will be sent upon request.

W. E. KENNEY & COMPANY, Watertown, N. Y., announce that they have disposed of their entire interests to the W. E. Kenney Company. This company will continue the business heretofore conducted under former partnership. With increased facilities the new company will make every effort to meet the demand for electrical merchandise and construction.

THE FRENCH BATTERY COMPANY, Madison, Wis., announces the removal of all of its manufacturing from Chicago, Ill., to Madison, Wis. The company will retain an office and salesroom at 69 Wells street, Chicago, but its main office and factory will be established at Madison. The company announces a very gratifying demand for the "Fleur de Lis" dry batteries.

THE SAFETY-ARMORITE CONDUIT COMPANY, Pittsburg, Pa., announces that it has brought suit in the United States Circuit Court for the Southern District of Ohio, under its patent for cleaning and enameling pipe for use in electric iron-armored conduits, against the Mark Manufacturing Company, Chicago, Ill., doing business at Zanesville, Ohio. The Safety-Armorite Conduit Company alleges infringement of its patent.

THE ABNER DOBLE COMPANY, San Francisco, Cal., announces the destruction of its works by the fire of April 18. Temporary offices have been opened at the residence of President W. A. Doble at 2611 Broadway, between Scott and Devisadero streets, San Francisco. Work on new shops has already begun. Manufacturers of machine tools, foundry and shop supplies and equipment are requested to send catalogues and price lists.

THE DRIVER-HARRIS WIRE COMPANY, Harrison, N. J., manufacturer of "Advance" resistance wire, and also of the brands known as "Hercules" and "Climax," is making material enlargements in its shop facilities, providing a number of new machines. This enlargement has become necessary by reason of the great growth of its business during the past few months. It is probable that the company will, in the near future, build an extensive addition to its factory.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York city, has ready for distribution its catalogue No. 21. This contains 736 pages, describing and illustrating practically every piece of apparatus in use for electrical work. The catalogue is supplemented by a carefully arranged index to the list numbers, and a general index alphabetically arranged, covering twenty-four pages. The book is well printed, is six by nine inches, and is substantially bound between boards and a tough buckram cover.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., has ready for distribution a handsome catalogue descriptive of its electrical wiring supplies. This catalogue illustrates, describes and gives the prices of switches, cutouts, rosettes, combination switches, weatherproof sockets, flush receptacles, porcelain base switches, cord adjusters, pendant switches, switchboards, panelboards, iron service boxes, panel cutouts and fuse blocks. This catalogue is designated as No. 6, and will be sent to any one interested upon request.

THE GENERAL STORAGE BATTERY COMPANY, 42 Broadway, New York city, will have an elaborate exhibit at the convention of the National Electric Light Association, Young's Pier, Atlantic City, N. J., June 5, 6, 7 and 8. The exhibit will include the "Bijur" high-duty storage battery and switchboard, charging generator, yacht lighting battery and switchboard, and standard railway signaling plant, a constant-current booster, and exhibits of car-lighting cells. The company will also make this exhibit at the Master Car Builders' and Master Mechanics' convention, which will be held at the steel pier, Atlantic City, from June 13 to June 20.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has secured an order from the Camden-Atlantic City line of the West Jersey & Sea Shore railroad for ten G. E. 69 (200-horse-power) double motor equipments with the Sprague-General Electric type of control. These motors, with their controlling apparatus, are duplicates of fifty-eight equipments previously ordered for this electrification project. Another company which has recently increased its rolling stock is the Brooklyn Rapid Transit Company, which has added 200 G. E. 80 (forty-horse-power) motor equipments. Twenty-five four-motor G. E. 54 (thirty-five-horse-power) equipments have been ordered by the Rochester Street Railway Company. The power station of the International Railway Company, Buffalo, N. Y., is being enlarged to meet the demand of the increased power for railway work. Two 1,000-kilowatt, twenty-five-cycle, three-phase rotary converters with transformers, switchboards, etc., have been ordered from the General Electric Company.

THE ARNOLD COMPANY, Chicago, Ill., announces its removal to the sixteenth and seventeenth floors of the Borland building, corner La Salle and Monroe streets. The company is distributing a pamphlet illustrating the building and showing the sixteenth floor plan of the new offices. The scope of the field covered by the Arnold company is shown by some of the work now being done in that office. As engineer and constructor the company is building the entire Elgin & Belvidere Electric Railway, a thirty-five-mile interurban road which forms the connecting link between two important electric railway systems in northern Illinois. The company has just finished the construction of complete shops for the Cincinnati, Hamilton & Dayton Railway, at Ivorydale, Ohio. The Big Four system has retained the company as consulting engineer for its new shops at Indianapolis. The company is making plans for two more hydro-electric plants for the Spring River Power Company, near Joplin, Mo. This is but a brief reference to the very extensive work which the company is now carrying on. The officers of the Arnold company are: Bion J. Arnold, president; W. L. Arnold, vice-president; Ralph G. Arnold, secretary-treasurer; George A. Damon, managing engineer.